THE IRON TRADE REVIEW

VOLUME XXVII. CLEVELAND, O. MARCH 8, 1894. CHICAGO, ILL. NUMBER 10.

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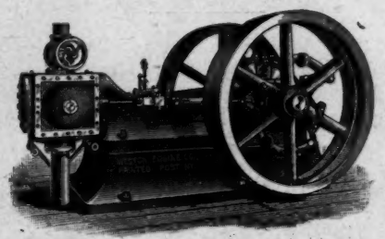

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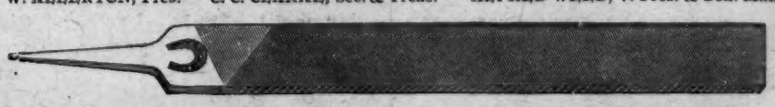

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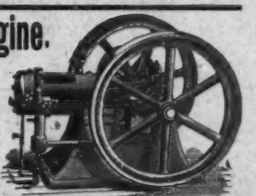

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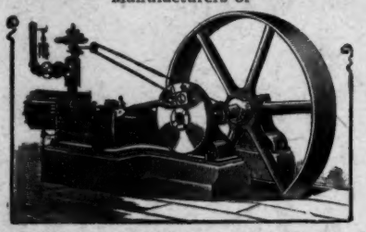

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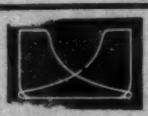

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THE IRON TRADE REVIEW

VOLUME XXVII. CLEVELAND, O. MARCH 8, 1894. CHICAGO, ILL. NUMBER 10.

THE WEEK IN IRON CIRCLES.

GENERAL FEATURES.

It cannot be said that the opening week of March has brought any encouragement to the iron trade. Quietness prevails at centers usually most active. The reaction from the spurt of a few weeks ago, that gave rise to so many predictions of betterment, has been complete, and there is evidence beside that prices have slipped below the point maintained previous to the advance. The heavy consumption of soft steel is still the factor of chief importance in the situation. The first week of March has brought the resumption of four blast furnaces in the Valleys and the Pittsburg district, all of which are to contribute to the growing volume of Bessemer production. If the buying of the past week were taken as a criterion it would be said that the drift was backward. From every pig iron market in the country the report comes of limited transactions, and a disposition to wait and feel the way. The best sellers can do is to work off their product in small lots and give buyers the benefit of inside figures. Pig iron stocks accumulated somewhat in February, and on foundry and forge grades, at least, the tendency is still in that direction. Opinions differ as to the effect of the low prices of ore outside the soft steel market, but it is apparent that the new basis will at least draw the line more closely on Southern irons, and favoring freights will not cut so large a figure in marketing the product of that section. The rub is now on the cost at furnace, and Northern producers have attained something more than the freedom of their own door yards, with cheap ore and coke and labor. Pittsburg reports further weakness in Bessemer pig and billets. There is a shortened demand for both and a round lot of Bessemer pig was sold at $10.50. It is reported that several thousand tons of billets have been disposed of at $15.25 at maker's mill. In finished material, along with stories of lower prices, are beginning to come up questions as to quality, and there may be sequels to the inroads of 1.15c plates, for example, in Eastern markets, that will not be profitable either to buyer or seller. It would seem that the developments at Washington are cutting a larger figure than ever in business calculations, now that the tariff situation has again been resolved into chaos.

THE CLEVELAND OUTLOOK.

A lull has followed the heavy opening sales of ore reported last week. As further details are available it appears that the total sold to date is closer to 2,500,000 tons than the figures thus far given. In this total, Mesabi ores have no part beyond the 100,000 tons of second-grade Bessemers sold at $2.25; and while it has been a long time coming, it must be said that the response of the old range companies to the exuberant claims of Mesabi promoters is emphatic and unanswerable. Nowhere in the trade is there any satisfaction with the basis on which business thus far has been done; it is perfectly well understood that even to the largest producers the prices made take no account of dead work and that the succeeding year's output can only be won at an increased cost. It will take time to determine to what extent Mesabi producers can work out their salvation, with the bulk of the best Gogebic ores out of their way. If a 6,000,000-ton requirement of Bessemer ores proves to be a correct estimate, there will be a market for nearly all that the leading Mesabi mines can get down, and the question will turn on the 25 cent difference between the ideas of furnacemen and ore men. There are Mesabi producers, whose ores are low in moisture and high in iron, who assert that $2.75 is their price and that it will not be lowered. Trial lots have been sold by three Mesabi companies within the past two weeks, with a view to larger orders later in the season. There has been further chartering of late at 80 cents from the head of the lake, but the limit on such contracts, which was Oct. 15, and then Oct. 1, is now said to be further shortened.

Pig Iron. The resumption of Etna furnace in the Shenango Valley and of Brier Hill and Girard in the Mahoning Valley has added considerably to the production of iron since the opening of the month, but the greater part of this added product goes into the mills of allied producers. Independent furnaces find the market weaker, and Bessemer is back to the low basis of a month ago. Foundry iron moves only in a small way—car lots being the buyer's favorite requisition—and prices are correspondingly weak. Charcoal iron arouses little interest among consumers and its displacement by coke iron goes on apace. There is no disposition to make season contracts; even with the greatly shortened production stocks are more than adequate to the demand. From a production of 576,964 tons in 1891 and 537,621 tons, 1892, charcoal iron fell to 386,789 tons in 1893, a decrease of 28 per cent. while coke iron production declined but 21 per cent. from '92.

Finished Material. The low prices on bar iron, which have been forced close to the one-cent basis, have brought a crisis in the Mahoning Valley. Though the present scale arrangement expires April 1, mill owners have sent an address to their men practically conditioning further production of iron in March on a voluntary reduction of puddling to $4, and a district convention of Amalgamated men is now in session to give an answer. The volume of business in finished material is fairly well maintained but prices are lower. On beams and channels 1.20 Cleveland is mill quotation. Competition on desirable jobs has gone below this. Freight rates out of Cleveland have been cut in an irregular way and as compensation Pittsburg shippers have secured reductions of 20 to 25 per cent. on west-bound iron.

THE CHICAGO OUTLOOK.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Another quiet week has passed, with no distinguishing feature to make it remarkable. Crude iron is in about the same shape as was last reported—sales limited to small lots, with no indications of any immediate betterment. Finished material is also quiet, with small sales and no very encouraging outlook. Rail situation unchanged.

PIG IRON.—Lotal coke continues to hold the lead it has obtained, and seems to be gaining, in point of sales, on Southern iron, all the time. There was no increase of sales of local iron this week, although a fair number of small orders, and one or two for amounts as large as 1,000 tons have been received, but sales of Southern iron appear to be dropping off. The largest single order reported fell a little short of 500 tons, and as a rule buying was limited to car load orders. In Lake Superior charcoal business has been quiet, only one or two car load orders having been received. Prices are a little weaker, our quotations given elsewhere being lowered slightly.

BARS.—Business has been limited to small orders, a transaction of 100 tons being considered large. Mills report spec fications coming in very slowly. Near-by mills continue to make a quotation of 1.10c to 1.20c Chicago, while Valley are fairly firm at 1.10c mill—1.23c, Chicago. Steel bars are unchanged at 1.30c.

STRUCTURAL MATERIAL.—Nothing new of any consequence has transpired, orders continuing to be for only small lots. Prices are unchanged at our last quotations. Beams and channels, 1.50c to 1.60c; angles, 1.40c to 1.50c; plates, 1.45c to 1.50c; tees, 1.75c to 1.80c.

RAILS AND TRACK SUPPLIES.—Buying continues restricted, with no indications of any large increase in the near future. It is expected that the South works of the local company will be started before the end of the present month. Quotations are unchanged. Rails, $25 to $27; splice bars, 1.50c to 1.55c; track bolts, 2.50c to 2.55c; spikes, 1.90c to 1.95c.

BILLETS AND RODS.—A few small orders have been received for billets, and while the demand continues for rods no sales have been made. Prices are unchanged, at $18.50 for billets and $25 for rods.

PLATES.—There appears to be no change in the volume of business, which is small. Prices are as last reported: tank steel, 1.45c to 1.50c; flange steel, 1.85c to 1.90c; fire-box steel, 3 75c to 4c; tubes, 70 and 5 off.

MERCHANT STEEL.—There is no change to report in the condition of the trade. Business is still small, and specifications hard to get. Open-hearth spring, machinery and tire steel, 1.90c to 2c; crucible spring, 3.50c; machinery, 4.50c to 4.75c; tool steel, 6½c and upwards.

SHEETS.—The market for black sheets remains quiet, though it is being pushed hard by the manufacturers. Quotations are still made at 2.40c to 2.50c, Chicago. Galvanized sheets are very dull, with quotations reduced to 75 and 10 and 5.

OLD RAILS AND WHEELS.—An order for 1,500 tons of old iron rails has been taken at private terms, for delivery out of the city. Quotations are maintained at $11. Nothing has been done in old steel rails, which are unchanged at $9.50 to $10 for long and $7 for short lengths, and old wheels are quiet at $10.50 to $10.75.

SCRAP.—Business continues to be very light, and prices are unchanged. No. 1 forge, $9 to $9.50; No. 1 mill, $6 to $7; No. 1 machinery, $7.50 to $8; axles, $12; cast borings, $3.50; wrought turnings, $4.50; axle turnings, $6; mixed steel, $5.25; coil steel, $7.50; leaf steel, $8.50; low tires $9; heavy cast, $8; stove plate, $5.50 to $6.

GENERAL MARKET RESUME.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Pittsburg. The week just ending has developed further declines in nearly all materials. In some departments the volume of business is larger, but the capacity of the mills is so much beyond going business that every slight betterment in tonnage seems to beget a greater anxiety by manufacturers to operate their plants as full as possible. There is a moderate demand for Bessemer iron. Two transactions of considerable size are noted this week, the price being given as $10.55. The demand for foundry iron is not what it was a week ago, and 25-ton and 50-ton lots represent current buying. Gray forge has kept up an even pace, with prices unchanged. The market to-day is about $9.60. Steel billets show further weakness and there are reports of sales below $15.50; in connection with one transaction $15.25 maker's mill was named. At Edgar Thomson, rails are the product at present, and the billet supply will be further shortened a few weeks hence by the stoppage of Duquesne for putting in a new blooming mill.

Cincinnati. In the latter half of the week inquiries and sales were more liberal than for some time past. The demand for the month past has been so slack as to lead dealers to wonder how foundries and mills could run at all, considering the fact that stocks on hand are exceptionally light. The widely advertised sales of ore at record breaking figures; the low prices going on coke: the reductions of labor, and some tendency to softening of freight rates, have led buyers to believe that still lower prices are to be reached. They fail to appreciate, however, the extraordinary fact that all of these items, tending to lower cost of production, were discounted far in advance. It is likely, that those who are delaying purchasing on the assumption there is absolutely no bottom to the market may meet disappointment. Production continues about stationary, but stocks, owing to the holding off above referred to, probably increased slightly during February.

Detroit. F. B. Stevens, 74 Griswold street, writes under date of March 5: "Nothing has occurred in this locality during the past week to disturb the prevailing quiet of the Lake Superior charcoal iron market. No orders have been taken or any offers made under fifteen dollars, though it may be possible that this figure would be shaded to the purchaser of a round lot with the ready cash for such an investment. It is evident that the manufacturer of charcoal pig iron is scratching his head to devise ways and means of economizing the cost of his product, and woe betide the furnaceman who has not equipped his plant with the latest improved methods of accomplishing this result. There are consumers of pig iron who recognize a good opportunity and take advantage of it. Such a manufacturer in this city bought last week something over a thousand tons of Southern iron for scattered delivery, and several orders of respectable dimensions were entered for Southern metal from interior parts of the State."

Louisville. The week has been a dull one, with very little iron sold and with sharp competition for all orders. Save on certain grades, the present low prices have continued and on deliveries running through the year. No. 2 soft and gray forge are rather scarce and there is a wide difference in the prices asked by different furnaces, some being fully sold up for the immediate future and not caring to sell at present prices. There is nothing doing in car wheel iron. Old wheels are a drug on the market.

THE IRON TRADE REVIEW

DEVOTED TO

IRON AND STEEL MANUFACTURE, FOUNDRY AND MACHINERY TRADES, IRON ORE PRODUCTION, TRANSPORTATION, AND GENERAL INDUSTRIAL PROGRESS.

PUBLISHED EVERY THURSDAY BY

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B. M. GARDNER, Associate Editor and Western Manager.

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ENTERED AT THE POST OFFICE IN CLEVELAND, O., AS SECOND CLASS MATTER.

MARCH 8, 1894.

LOW PIG IRON COST IN CLEVELAND.

The talk of removing the Johnson Co.'s plant from Johnstown, Pa., has led to the consideration of a number of new points thought by the company to be eligible. And whether the outcome of the matter is the erection of a modern steel rail plant elsewhere, or merely the securing of desirable concessions, railroad and otherwise, that will warrant building at Johnstown, the campaign has brought out some interesting information as to the comparative cheapness of pig iron production in the localities investigated. It may be said broadly that, given a plant of modern construction and equipment in every particular, the statistics gathered in connection with the Johnson Co.'s quest show that Cleveland is the most advantageous point in the country for the production of steel. Low cost of assembling materials, low interest, taxes and maintenance charges, and facilities for distribution that insure favorable freights on manufactured product—all combined to make the most favorable showing for Cleveland as an iron-making situs. While coke freights are in favor of the valleys, and the Cleveland cost of labor is probably somewhat higher, these advantages are more than overcome by the fact that the cost of ore on dock is practically the cost of the ore in Cleveland furnace yards.

In making the figures below, as to the cost of Bessemer pig iron in Cleveland, with a modern blast furnace plant, we have made the cost of a 65 per cent. ore $2.75; of a ton of coke, $1, and have made the fullest allowance on casting house weights, in addition to reckoning the larger amount of coke required in foundry iron. The labor cost is probably above the present basis:

3,350 pounds of ore for the mixture to produce 2,300 pounds of iron, casting house weights	$4.44
Coke necessary for a ton of foundry iron	2.94
Limestone	.18
Sand	.05
Coal under boilers to ignite gas	.10
General repairs	.10
Tools, incidentals, accident and investment	.40
Labor	1.00
Total	$9.21

The advantage over the valley, carefully computed, is about 50 cents, to which should be added the 65-cent freight to Cleveland or Pittsburg, which must fairly be taken into consideration in connection with the marketing of valley product.

These are not the days of steel mill building, nor is there any call for an enlargement of the country's capacity for rail-making; but when the time comes for further investment in this direction it will be found that Cleveland offers economies not to be compassed at any other point in the country.

HARDSHIPS OF UNEQUAL SHRINKAGE.

One of the aggravations of panic conditions is the uneven shrinkage of values. The wage earner who has been reduced 20 to 25 per cent. or more, while his income is further cut down by shorter hours or irregular employment, finds that rents hold up to the figure of prosperous times; that the food for his table brings substantially the price prevailing six and twelve months before; that clothing and fuel, if at all changed, are but a shade lower; street car fares and doctor's bills are on the old basis—and so on down the line. Practically, the wage earner is without compensation for the hardship of reduced wages; or, if new adjustments come in the prices of the things he buys, they lag far behind the time of his sharpest necessity and are never scaled to the measure of his loss. In time, theoretically at least, there is bound to come the settling of prices in articles of general consumption, because shortened consumption due to curtailed ability to buy means over-supply and the familiar law comes in to weaken values.

On the manufacturers' side this same lack of ready adjustment in the machinery of trade works hardship no less severe. To begin with, labor's demands are not always timed to market conditions. It is too often the case that strikes are made on a falling market, when competition is sharpest, or when pressure of contracts—taken, perhaps, at the lowest living figure—compels speedy concession. It is forgotten, many times, in the loose and wholesale assertion often heard, that labor bears every loss and is first to feel every blow at industry, that shops have kept running long after operation has ceased to be profitable and that capital bears losses in silence, waiting for the better day, when the balance will appear on the other side. Without doubt there are hundreds of establishments in which business has been done practically without a profit the past year, while wages have gone on unreduced, and many times that number whose losses have not been measured by the slight wage reductions enforced. The Illinois Steel Co.'s balance sheet, for example, with its item of $1,467,371.61 charged to profit and loss, is an illustration of the prodigious shrinkage that vested interests often undergo, without a chance at compensating economies, whatever reductions are made in labor cost being only proportioned to the fall in current prices of product into which such labor goes.

One of the most conspicuous examples, perhaps, of the hardship to manufacturers from the disproportionate shrinkage of what they sell and what they buy, is found in transportation charges. Iron manufacturers, in particular, have been made to feel this, since their product has been a leader in the downward march. While the iron trade has suffered double distress in having both prices and volume seriously reduced, the railroads of the country have maintained rates on iron products and have been affected only as the volume of traffic fell off. The enforcement of the Spring reduction two months earlier than usual is the only step taken indicating a thought of the situation, and that was too insignificant to have serious mention as a mitigation of the existing conditions. On pig iron, for example, there has never been any effort to gauge freights to the market price. While two years have brought an average reduction of, say, 30 per cent., freights remain the same, at least so far as Northern irons

are concerned. On manufactured material, there has been somewhat more flexibility, particularly on shipments from Central Western points to the East, but these concessions have been so exceptional as to call out sharp complaint from parties not favored.

We believe a policy of straight out reduction, such as Lake Superior roads have announced to the iron ore producers of that region, is called for by the condition of the iron trade generally, and that railroads making it will be only righting an inequality that has been long borne in patience. Certainly the course of the iron trade the past three years has been demonstration plain enough that its falling values are not a panic incident, and that whatever advance comes from the prices of to-day will not restore the basis of '92 or even of early '93.

CAR wheels at less than 1 cent a pound emphasizes a fact that may have more attention later on than it seems to be receiving in the heat of the present struggle for business. Quality may count for more, when wear and tear demonstrate that low priced material is not necessarily cheap. A buyer who went into the old car wheel market rather extensively some time ago, believing the investment a good one at prices then current, has had his eyes opened since he has called an expert to his assistance and had tests made of his property. There are signs in other departments of the market that the desperate cutting of prices has been attended by deterioration in quality and that there will come a reckoning that will not be altogether profitable for buyer or seller. There are limits of safety that cannot be exceeded with impunity, and the low price regime has brought with it too many temptations for the good of the trade.

VARYING statements have been made from time to time as to the working of Mesabi ores in the blast furnace and as to the proportion that can be used to advantage. At the Edith Furnace of the Oliver Iron & Steel Co., in Allegheny City, 75 per cent. and as high as 80 per cent. has been employed. On the operation of the furnace with this proportion, the manager, Mr. John Reis, writes *The Iron Trade Review* as follows: "I give you the work of the furnace for the month of February, using 75 per cent. Mesabi (South Side) in our mixture. We made for that month 6,455 tons of Bessemer, an average of over 230 tons per day. Greatest day's record, 263 tons; greatest week's record, 1,701 tons. The furnace is only 16 x 75 feet and has been in blast about two years and six months. This, I think, is more than satisfactory work."

IT is a suggestive commentary on present conditions that a bridge building concern can figure actual cost on every item of a contract about to be let and yet make a fair profit on the decline in values of material between the time of bidding and the date of its contracts with the mills.

AMONG THE IRON MINES.

In all the history of mining in the great Lake Superior basin in the last 40 years, nothing has been seen at all approaching the excellent showing of ore at Section 21, near Ishpeming. For a distance of three-quarters of a mile the Winthrop, on the N. ½ S. W. ¼ and the Mitchell on the N. W. ¼ S. E. ¼ of Section 21, 47, 27, have, at various depths, ranging from 500 to 700 feet, mined out the ore up to the line on the north of them, leaving throughout the entire bottom of both mines great stopes of ore, in plain sight and upon different levels, from 40 to 70 feet high, all dipping upon lands belonging to the Lake Superior Iron Co.

To reach a part of this ore the Lake Superior Iron Co. have put down two large shafts upon the S. E. ¼ of N. W. ¼ of Section 21 and will eventually go down with others upon the S. W. ¼ of N. E. ¼, while they have two shafts already upon the S. W. ¼ of the N. E. ¼ of the same section which is the old Lowthian mine. Large bodies of ore have been found at all these shafts and developmental work is going on at two of them, where quite large stock piles have been raised during the winter from simply sinking the shafts and driving the necessary drift for future levels. In both shafts at the Lowthian considerable ore was left in sight when the mine closed down years ago. For some time past negotiations have been going on between the owners of the Winthrop and Mitchell mines and the Lake Superior, the object being for the Lake Superior to get control of the two worked out mines. This it is now understood has been accomplished, so that this week the Lake Superior Iron Co. assumes charge of the property. Upon Section 21 there has lately been built a large mining plant, with a four-drum hoist attached to double Corliss engines; wire rope will now be extended from here to each of the new shafts and one to the Winthrop No. 1, and also one to the Mitchell incline shaft, at the bottom of each of of which there lie these huge stopes of ore ready for the miner. Should the market require or should the management choose there could this year be raised at least 200,000 tons of ore. Cheaper ore could nowhere be got, not even upon the steam-shovel Mesabi range. The stopes are dry, the shafts sunk, the drifts opened, the hoisting plant ready. On surface, the tracks are laid, the pockets built, and all things ready for a big output. This change in control only affects the older worked-out portion of the Winthrop and Mitchell, and while it gives advantages to the Lake Superior for a more economical working of ore, it in no way interferes with the South Winthrop, or with future explorations in the Mitchell which own three other 40-acre tracts, where the indications are more than good for other bodies of ore. The South Winthrop looks well and ore has been reached in two levels which as mined out will lead to other bodies. On March 3 the Winthrop Iron Co. discontinued work at the Mitchell mine, throwing out 200 men. The lease will probably be surrendered to the owners of the fee, the Pittsburg & Lake Angeline Co.

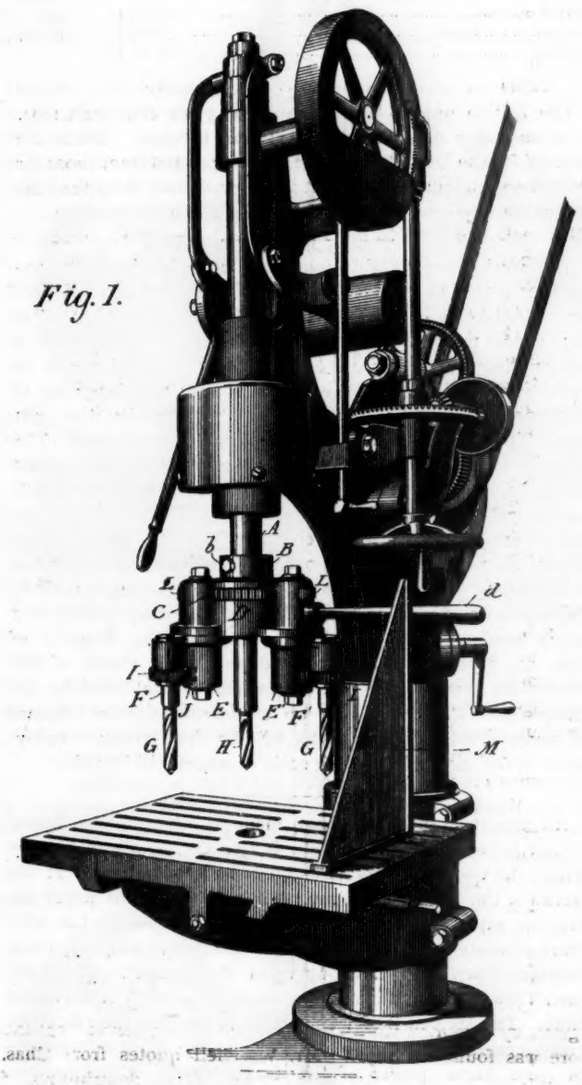
One of the most interesting papers presented at the second annual meeting of the Lake Superior Mining Institute, which began at Houghton, Mich., March 7, was that of Horace V. Winchell, of Minneapolis, under the title, "Historical Sketch of the Discovery of Mineral Deposits in the Lake Superior Region." Mr. Winchell refers to the little respect held by the average mining man for the science of geology, and proceeds to show, by citations from the history of iron ore development in the Lake Superior region, that the mine owner would have discovered his hidden wealth sooner had he read understandingly the geological reports of his region, besides saving money in the development of his mine. He refers to the statements made by Mr. R. A. Parker, of Marquette, in an article in the *Engineering Magazine*, to the effect that the Penokee-Gogebic discoveries are traceable to "rumors (in 1883) of the occurrence of soft red hematite" and "the discovery of ore beneath the roots of a tree;" that the Vermilion range was found by explorers in 1875, and, in the case of the Mesabi, that "discouraging reports of the district had been given by explorers and geologists," but "by perseverance the ore was found in 1891." Mr. Winchell quotes from Chas. Whittlesey's geological report of 1849, giving descriptions of the "magnetic iron beds of the Penokee range;" cites the first account of Vermilion range iron ore in the report of State Geologist Eames in 1866; and as the initial publication concerning the Mesabi refers to Mr. Eames's account, in his report of 1866, of the occurrence of iron ore on the Western end of the range at Prairie river, several analyses being given. "Favorable mention is also made of the Mesabi," Mr. Winchell adds, "in various other geological reports between that time and 1891." Mr. Winchell sums up thus: (1) The ore on these three ranges was found by geologists who published accounts of their discoveries and all reports to the contrary are but idle tales. (2) The accuracy and trustworthiness of these early reports has been fully demonstrated by subsequent developments. (3) Had the mining public given due credence to these reports it might have reaped the benefit from them a quarter of a century sooner than it did.

DRILL PRESS ATTACHMENT.

Mr. J. N. Barr, of Milwaukee, superintendent of the Chicago, Milwaukee & St. Paul shops, has invented a drill press, illustrations of which are presented on this page. The device on which the patent was secured may be instantly applied to or removed from the spindle of an ordinary drill press so that the machine may operate at one time a number of drills. It consists of a frame adapted to be attached to and sustained and adjusted by the ordinary spindle of a drill press, and containing a series of secondary drill spindles and gearing through which they may all be operated at one time from the main spindle.

Fig. 1 represents a perspective view of an ordinary drill press provided with the attachment. Fig. 2 is a side elevation of the attachment with one end shown in vertical section. In these illustrations A represents the spindle of an ordinary drill press combined with mechanism by which it is rotated and

Fig. 1.



raised and lowered endwise at the will of the attendant. B is a sleeve or collar adapted to fit snugly over the lower end of the spindle, and provided with a set screw *b*, or other means, by which it may be firmly attached to the spindle, so as to be sustained and rotated thereby. The sleeve B is provided with an encircling gear C fixed rigidly. The sleeve is also encircled by and supports a secondary drill-carrying frame D, to which there are connected secondary frames or arms E, E′, having vertical journals K, seated therein, so that the secondary frames may be swung horizontally around their journals. Each of the arms E E′ carries at its outward end a vertical rotary spindle F, with the projecting lower end socketed to receive a secondary drill G. As these drills are carried in the outer ends of the arms, the horizontal turning or swinging motion of the arm has the effect of changing the distance between the drills G and a central drill H, carried by the spindle of the drill press.

Each of the secondary spindles is provided with a driving pinion, I, receiving motion from a pinion J. The pinions J are each mounted on a vertical shaft or spindle K, passing vertically and axially through the arm E, and carrying at the upper end a pinion L, which engages with the main gear C, before referred to.

The frame D is provided with a laterally-projecting arm *d*, adapted to bear against and slide along the vertical edge of the plate M, which is bolted temporarily to the bed or other suitable portion of the press for the purpose of preventing the rotation of the frame D, while allowing it to be raised and lowered by the spindle. When the spindle A is set in motion it rotates the sleeve B, and its gear C, which latter in turn imparts motion to the pinions L, and thence through shafts K, and the pinions J on the lower ends of said shafts, to the pinions I on the secondary spindles.

The frame D and the various parts mounted therein thus constitute a portable attachment which, being applied to an ordinary drill press, enables it to operate in addition to its ordinary drill a series of secondary drills turning in the same direction and adjustable to and from the central drill at will. The attachment as a whole is sustained and adjusted vertically by the main spindle, the main and the secondary drills being controlled alike in their vertical movements. While the frame B is represented as provided with only two arms E E′, it is to be understood that the number may be increased to any desired extent. In order to control the relative depths of the

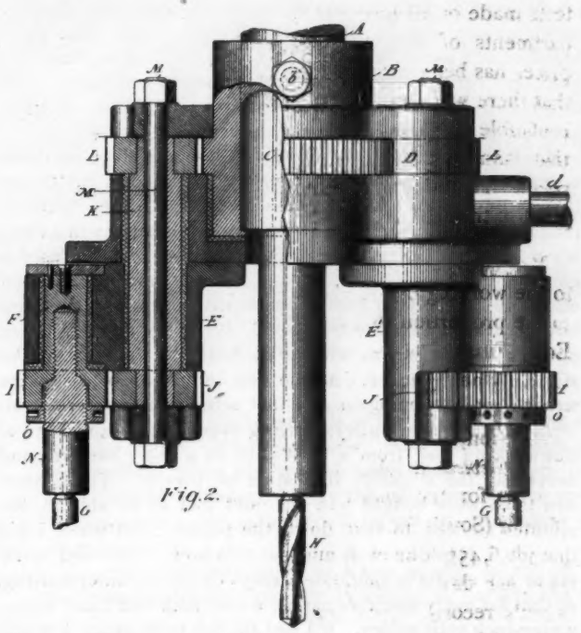


Fig. 2.

holes formed by the several drills, each of the secondary spindles F is provided with a drill-carrying socket N, screwed therein so that it will be raised or lowered in relation to the spindle, and these sockets are locked by means of jam nuts or collars O. In the event of its being required only to drill the several holes in a constant relation to each other the swinging arms E E′ may be dispensed with and the secondary spindles mounted directly in the frame D. In making use of this second form of the device it will be fixed upon the spindle of a drill press or other machine in the same manner as the device just described and will be prevented from rotating by an arm or guide of any suitable character.

While the device is shown above attached to a press having a longitudinal moving spindle, it is applicable in the same manner to that class of drill presses in which the rotary spindle is fixed against end motion and a rising bed employed to carry the metal against the drill.

THE lining of the Stewart furnace, at Sharon, Pa., gave out last week, and it was fouud necessary to take off the blast and shovel out. It will take six weeks of constant work before the plant will again be in full operation.

SHOP AND FOUNDRY NOTES.

"Machine tools may be classed in the main," says the *American Machinist*, "as slow-running, long-lived machinery, which is unfortunate in one respect. They actually last too long for the good of the user. There is an attachment for old machine tools that keeps them in service after skill in the art has produced something so much better that they ought to be put out of the way. The old lathe that did good work thirty years ago, is good to-day, because it was good then, so the argument goes; and so it is with a hundred other things. There are still shops using square shank drills because they have always been used, and because things in general are fitted to them. It often happens that the old tools and the old ideas prevail until new men build the new shop and equip it with new tools and new ideas. The old shop often dies because of its burden of old tools."

The Lake Shore Foundry, of Cleveland, entered suit last week against the city to enjoin the carrying out of a contract with J. B. Clow & Son, of Chicago, for the purchase of World's Fair water pipe. The bid of the Lake Shore Foundry $21.45 was lowest on new pipe. City officers have word from Indianapolis that the Lake Shore Foundry furnished pipe there a few months ago at $19.40.

Ten molders have struck at Walters & Walker's stove foundry, Sharpsburg, Pa., against employing seven apprentices. According to the rules of the Molders' International Union but three apprentices could be employed in the shop.

A cement for cast iron, recommended by Simpson Bolland, is composed of clean borings or turnings of cast iron, 16 parts; sal-ammoniac, 2 parts; flour of sulphur, 1 part. Mix them together in a mortar and keep them dry. When required for use, take of the mixture, 1 part; clean borings, 20 parts. Mix thoroughly and add a sufficient quantity of water. A little grindstone dust added improves the cement.

Has it ever occurred to you that there are some methods coming into vogue that are cheaper in the long run to use than to be without? Among these is the split pulley. It costs money, and big money, too, at times, to cut a keyway in a shaft when a new pulley is to be located. Have you ever used a good split pulley? If not, do so. A short time since I fitted out a whole shop with pulleys and shafting, and used nothing but split wooden pulleys. Hold? Well, not at first. Each pulley was tightened as well as we could do the work at the start and then watched. At the first indication of a slip the wrench was put on again and that settled the matter for all time. I had those pulleys driving every conceivable kind of ironworking tool, from a light drill to a heavy hammer, and never had the slightest indication of trouble. Then, when new tools were bought and old ones had to be shifted, ten minutes sufficed to take down the pulley. But when I did that job, I didn't know as much as I do now. I allowed builders to sell me tight and loose pulleys on the countershafting, so that for every machine having a four inch belt I had to buy a nine-inch split pulley. If I had the job to do again I would specify clutches. Of course the clutch would cost more than the extra paid for the double width split, and the additional loose pulley, but not so very much. And then I would save weight on my main line; and room also.—[J. H. Allen.

Tests of the Adams Boiler.

A test made by D. Ashworth, M. E., of Pittsburg, on three Adams patent upright water tube boilers, a total of 675 h. p. at the Falcon Tin Plate & Sheet Mill, Niles, O., showed excellent results. The boilers developed 941 h. p. and evaporated 9.74 pounds water for 1 pound combustible of low grade bituminous slack, hand fired, from 212° F. feed water. The steam pressure averaged 84 pounds. Temperature of waste gases, 467°. Moisture in steam, 0.6 per cent. The boilers were tested just as they were running the works every day, having been in constant use 11 months. As a result of the test an order was given the Adams Boiler Co., The Cuyahoga, Cleveland, for one of their boilers of 500 h. p., to be fitted with automatic stokers.

NOTICES have been posted about the Thomas Iron Works at Hokendauqua and Lock Bridge, Pa., announcing another reduction of 10 per cent.

PRODUCTION OF BASIC STEEL IN 1893.

The total make of steel and ingot iron from phosphoric pig-iron by the Thomas-Gilchrist process, during the year 1893, amounted to 3,638,556 tons, being an increase over the make for the previous twelve months of 435,916 tons. Of this total the make of basic Bessemer steel amounted to 2,808,241 tons, and that of basic open-hearth steel was 830,315 tons. Of the steel containing under 0.17 per cent. of carbon, the basic Bessemer produced 2,304,881 tons, and the basic open-hearth 596,716 tons. There were 874,000 tons of basic slag produced with the steel, containing about 36 per cent. of phosphate of lime, nearly the whole of which was used as a fertilizer. The makes of the various countries for the years ending Dec. 31, 1893, and 1892, respectively, are appended:

	1892.	1893.
Germany and Luxemburg	2,013,484	2,344,754
England	406,839	358,036
France	287,528	363,017
Austria-Hungary	288,122	314,992
United States	91,729	
Russia	58,664	257,757
Belgium	56,274	
Totals	3,202,640	3,638,556

The British output has fallen off 10.5 per cent from 1892. In all the other countries there was an increase. While the returns for the United States are not separated from those for Russia and Belgium for 1893, it is believed that, in spite of the panic, there was an increase of the product in this country.

THE weekly output of Connellsville coke has increased 20,500 tons since Jan. 1, 15,000 tons of this gain being in February. Production in the last week of February is estimated at 98,755 tons, 10,099 ovens being active and 7,414 ovens idle—a net gain of 319 ovens in the active list. The shipments to Pittsburg and river tipples were 1,928 cars; to points west of Pittsburg, 2,258 cars; to points east of Connellsville, 1,381 cars. This was a gain of 409 cars over the previous week. The *Courier* says: "The smaller operators have begun to exert themselves in the way of getting orders, and next week will see several of the small idle plants in blast. None of the operators are willing to make contracts very far ahead. They expect the price of coke to go considerably above $1 per ton before many months, and do not want to be caught with 85 and 90-cent contracts on hand when coke is being quoted at a much handsomer profit." A Mt. Pleasant, Pa., dispatch of Feb. 27, says: "The Moorewood and Alice plants of the Southwest Connellsville Coke Co., which is controlled by the Illinois Steel Co., are to start up to-morrow after an idleness of seven months. 1,200 ovens will be fired, giving employment to 600 men. The Frick scale of wages will be paid."

AN important move has been made by the McNeil Boiler Co., of Akron, O., and the Cook Boiler Co., of Cleveland, by which the Cook boiler is hereafter to be manufactured at the works of the former company. The readers of this paper are familiar with the Cook boiler and its adaptation to the utilizing of waste heat, as set forth in a descriptive article in these columns when it was first put upon the market. The Aultman-Taylor Co., of Mansfield have manufactured it for some time. The McNeil Boiler Co. expect to increase their facilities considerably. They now have orders on hand for upwards of 3,000 horse power of the Cook type. At the annual meeting of the company last week the following officers were re-elected: A. M. Cole, president; Geo. C. Berry, vice-president; J. B. Campbell, secretary and treasurer.

W. J. RAINEY will soon begin the erection of a large coke crusher at the Grace plant in the Connellsville region. At present there are only about four crushers in that region in operation. For domestic purposes, crushed coke is becoming an important fuel. It can be made and shipped to points in the West and Northwest at $2 per ton cheaper than anthracite coal.

THE breaking of a squeezer in the puddle mill at Bay View, Wis., has led to the laying off of 60 men, and it is not known when they will go on again. The company would prefer to close the mill, at present prices, under the present scale.

THE AMERICAN ENGINE.

We present on this and other pages illustrations and description of a high grade automatic engine built by the American Engine Co., of 45 Raritan ave., Bound Brook, N. J., a company organized in 1893 with a capital of $200,000. This company bought from the American High Speed Engine Co. their complete plant, and adopted the name of American Engine Co.

The claims made by the manufacturers are as follows: This engine retains all the simplicity of the single valve engine while distributing the steam as in the Corliss and other complicated engines, giving the highest attainable steam economy. Heretofore the consumer of steam power has had to choose between two evils, viz.: the evil of complication for good steam economy, or the evil of poor steam economy for simplicity.

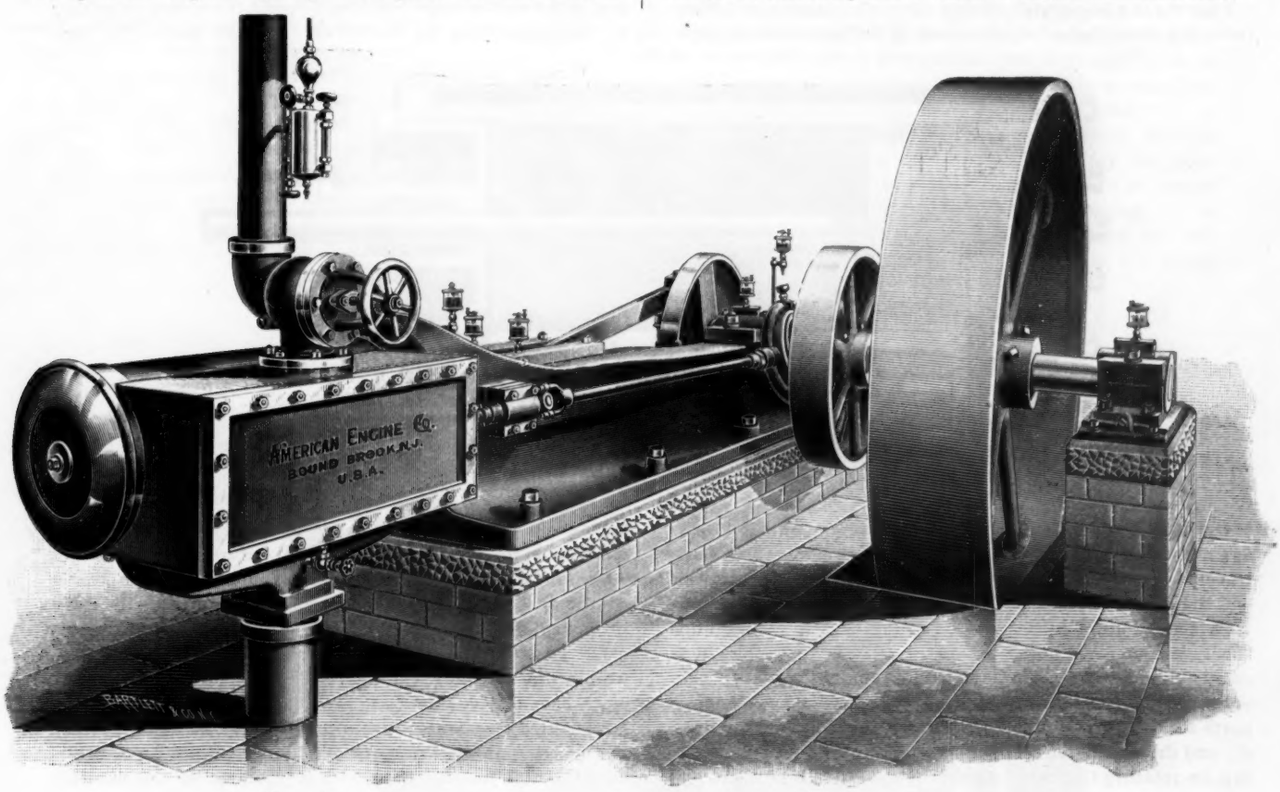


FIG. 1.

Referring to the above illustrations, Fig. 1 is a view looking at rear side of engine and shows a massive bed plate, with a square base to rest upon the foundation. The foundation is protected from oil and water by a bead which extends around the outer edge of the base and conducts the oil, etc., to a pit under the crank disc from which it is drawn out through a pipe and may be filtered and used again. The bed plate from cylinder to main bearing extends above the center line of strains, ensuring rigidity and freedom from springing. Fig. 2 is a view of the valve gear and single piston valve having the usual annular ports, one at each end, which control the admission of steam to the cylinder—the release and compression being controlled by the ends of the valve. Thus the movement of the valve to control these events is reciprocating, and is produced by the eccentric shown as it revolves around the shaft; the motion being transmitted to the valve by means of the eccentric rod and valve rod.

So far this description would apply to many of the numerous piston valves and operating mechanisms. The peculiarities are: First: The eccentric is fixed to the shaft, which makes the reciprocations of the valve invariable, thereby giving a constant admission, constant release, and constant compression. Second: The automatically variable cut-off is produced as follows: In addition to the annular ports this valve is provided with longitudinal ports and corresponding ports are cast in the stationary sleeve which is within the steam chest. (See Fig. 3). As the inner ends of the valve are closed, steam in order to get into the cylinder, must pass through these longitudinal ports, and will so pass when the ports in the valve coincide with the ports in the stationary sleeve; and the flow of steam to the cylinder will be cut off when these ports do not coincide.

Therefore, the admission of steam to, and the cut off from the cylinder depend upon the longitudinal ports in the valve

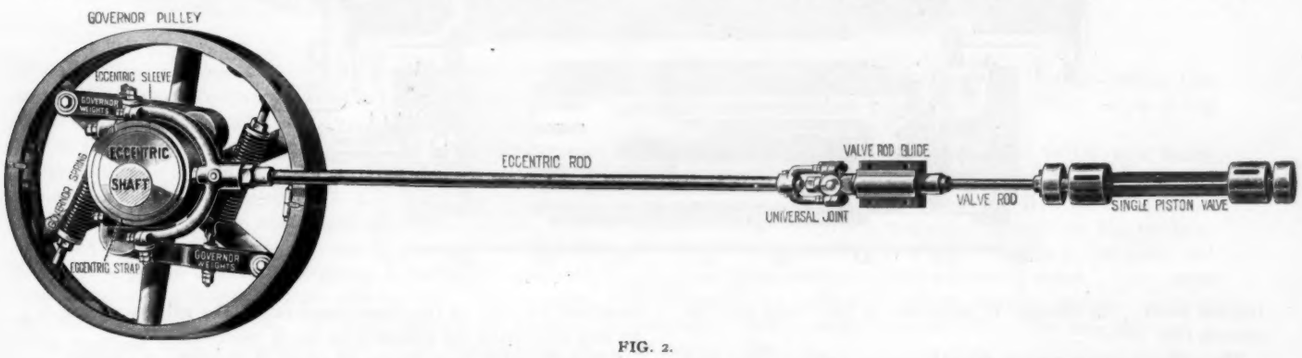


FIG. 2.

being brought into communication with the ports in the stationary sleeve, and vice versa. This opening and closing of these longitudinal ports call for a twisting motion to be imparted to the valve. This is accomplished by the eccentric sleeve, mounted upon the eccentric, having a diagonal V-shaped groove (See Fig. 5) turned in its periphery to which is fitted the eccentric strap. This sleeve is connected with the governor weights by links in the usual way of connecting eccentrics. As the sleeve revolves with the eccentric, being car-

ried around by the governor weights, a twisting motion is imparted to the eccentric strap and through the eccentric rod and valve rod to the valve. Thus the valve has two motions: One, an invariable reciprocating motion; the other, a twisting motion, which is invariable in degree, but variable relative to the reciprocating motion.

The American Engine Co. do not use piston valves in a horizontal position. Notwithstanding they are perfectly balanced against steam, their weight produces friction which causes wear, and soon results in leakage. They are used, however, in the company's vertical compound and triple expansion engines, in which their weight will be supported by the valve stem in a vertical position, doing away with friction and wear.

Figure 4 is a horizontal section through cylinder and illustrates the construction of valve used in the horizontal engines.

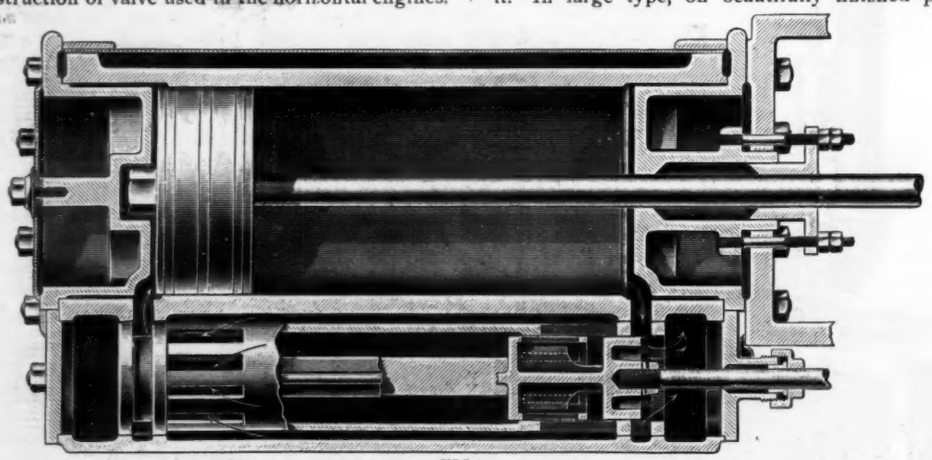


FIG. 3

It consists of a flat face slide valve bearing upon a flat seat, against which it is held by the steam pressure. The valve travel is invariable, hence the wear upon its seat is uniform, and therefore the valve always remains tight. This valve controls the admission, release and compression, maintaining them constant; while the cut-off is variably controlled by a small cylinder valve within the slide valve, as shown. This valve is provided with longitudinal ports, and corresponding ports are cast through the shell of the slide valve surrounding it; and the cutting off of the steam is accomplished by twisting, or rotating the valve which opens and closes the longitudinal ports. No change is required in the valve gear to actuate this valve.

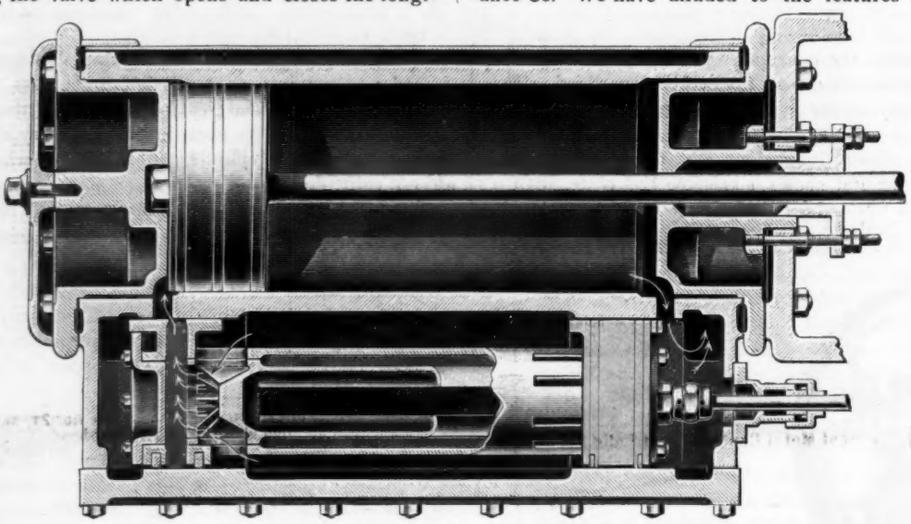


FIG. 4.

The exhaust steam passes directly to an exhaust pipe cast on the under side of the steam chest, the ends only being joined to the steam chest so that the exhaust does not come into contact with any live steam surfaces except the ends of the main valve. The live steam is conveyed by a pipe into the steam chest through the top at the center, and is prevented from passing into the ends of the valve to the exhaust by packing strips. The economy of small clearance space is fully realized in this engine, having but one short port at each end of the cylinder for the admission and eduction of steam.

PUBLICATIONS RECEIVED.

Numbers eight and nine of "The Book of the Fair," edited by Hubert Howe Bancroft, contain magnificent illustrations of the most marvelous of all the exhibits at Chicago—those contained in the great Machinery Hall. As with every number of this work, that is as much of an epoch-marker in the book world as the Chicago fair was among Expositions, Nos. eight and nine show what absolute fidelity to truth have been a law to editor and artist. All that the perfection of the printer's and illustrator's art could make them, these great folios are—it is hard to see, indeed, how they could be improved upon. A feature of number nine is the full-page illustration of the cold storage building fire and the scenes attending it. In large type, on beautifully finished paper, the text stands out luminously, pleasant to the eye and admirably wrought as to style, its directness and naturalness contrasting with much of the stilted matter extant. Even the reader who has no interest in machines will be attracted by the artistic choice of subjects for the illustrations that crowd the work. "The Book of the Fair" is published by the Bancroft Co., Auditorium Building, Chicago.

We have received the bound volume for 1893, of the *Locomotive*, that excellent monthly commentary on boiler practice published by the Hartford Steam Boiler Inspection & Insurance Co. We have alluded to the features of the monthly numbers for 1893, as they have come out. The volume before us well maintains the standard of its 13 predecessors.

"Duluth, with Snap Shots of 1893" is the title of a paper-bound handy volume that photographs the industrial achievements of the city at the head of the lake, in the panic year. In spite of the depression, Duluth's shipping record shows an increase of about 14 per cent. in freight in and out, comparing 1892 and 1893, the total for the latter year being 4,305,829 tons against 3,781,698 in 1892. The importance of the Mesabi range as an addition to Duluth's traffic is pointed out and a prediction made of a 3,000,000-ton shipment in 1894—from 40 to 50 per cent. higher than a conservative estimate would sug-

gest. The pamphlet is compiled by the Secretary of the Duluth Real Estate Exchange.

The *B. and O. Field* for February, issued from the office of the land and immigration agent of the Baltimore & Ohio Road at Baltimore, calls attention by means of attractive description and half-tones, to the advantages of West Virginia and Virginia points situated on that road, for manufacturing sites and for individual investors. Special excursions from Chicago to Shenandoah Valley points are announced for March 8 and April 9.

Lippincott's Magazine for March has "A Desert Claim" by May E. Stickney as its complete novel. Annie Nathan Meyer's article on Ibsen as the "Prophet of the New Womanhood," and the strong story of W. C. Morrow, "The Inmate of the Dungeon" are other noteworthy features.

"The High Building and Its Art," by Barr Ferree, attracts us, in March *Scribner's*. The illustrations are from the sky-scrapers of all cities, Chicago buildings, perhaps, getting most attention. "The Cable Street Railway," by Philip G. Hubert, Jr., will interest technical and untechnical readers alike.

March *Outing* opens up with a complete story, "The Pagliaccio's Courtship," a carefully drawn picture of Italian peasant life, from the pen of Jean Porter Rudd. Other features of an excellent number are: "The Rise of the Bottom Rail," a story of the South, by Jno. A. Williams Jr., and "A Leopard Hunt in Ceylon," by F. Fitzroy Dixon.

The *Cosmopolitan*, notwithstanding its extraordinary reduction in price is bringing into its pages the most famous writers and artists of Europe and America. The issue for March is a new revelation of strength and completeness.

"The City Tramp" is the instalment given in the March *Century*, of Josiah Flynt's interesting narrative of personal experience among tramps. Other articles are, "Earthquakes and How to Measure Them," by Prof. Edward S. Holden; "The Madison Square Garden," and "The Suppression of Bribery in England." Miss Anna L. Bicknell, who was an inmate of the Tuileries as an instructor, has a noteworthy article entitled "The Tuileries Under the Second Empire."

GEORGE G. LOBDELL, head of the Lobdell Car Wheel Co., died at Wilmington, Del., March 1, aged 80 years. He had been in the car-wheel business over 55 years and succeeded his uncle in 1839. In 1861 he began to make the Lobdell improved single-plate wheel, and in 1869 the Lobdell patent combination wheel.

ON THE PESSIMISTIC MARKET REPORT.

TO THE EDITOR OF THE IRON TRADE REVIEW:

I desire to say, for the benefit of those who write pig iron market reports for the different trade journals, that they are in a great measure responsible for the extremely low prices on this article. You are constantly crying "lower prices." I now refer to a recent report from Cincinnati, under date of Feb. 28, 1894, in which the reporter writes:

"The general feature of the pig iron market is *weakness* and it is evident that round lots of Southern coke Iron could be bought at lower prices; there have been sales of 2,000 tons No. 2 soft foundry iron at $7.00 f. o. b. Birmingham and for No. 2 regular *it is said* that $7.25 has been shaded; in fact, the whole market is so much demoralized that there appear to be no settled prices, but *it is strongly asserted* that a reduction of fully 25 cents per ton could be obtained on all grades."

The situation as we actually find it is bad enough, without referring to something that does not exist. Under the generally demoralized condition of trade, it is unjust for anyone to follow up a sale such as above referred to by saying, "It is strongly asserted that a reduction of fully 25 cents per ton could be obtained on all grades." Does the writer not know that he is the demoralizing element? Can he not realize that he is striking directly at the heart of trade; that he is doing all he can to ruin the manufacturer?

A word further to this reviewer: If the prices now being realized were exorbitant and beyond reason, then the situation would be different, but when it is known that at the present prices the manufacturer is not realizing cost on his product, you are the instrument which is driving him to the wall, and will make him (sooner or later) a financial wreck. Have some forethought and make your report shorter, and say nothing that will further unsettle matters. Give the manufacturer a chance for his life.

For many weeks such reports as referred to have been published. Several times outside lots were sold at greatly below what was known at the time to be regular market prices, and yet they appeared to the trade as being regular furnace lots through the reports that were published.

Let up for a while and give the manufacturer a chance to catch his breath; the *facts* are bad enough, therefore the least said in a report the better. Give your figures from week to week and *let up* on your tale of woe, and a better state of things will result.

P.

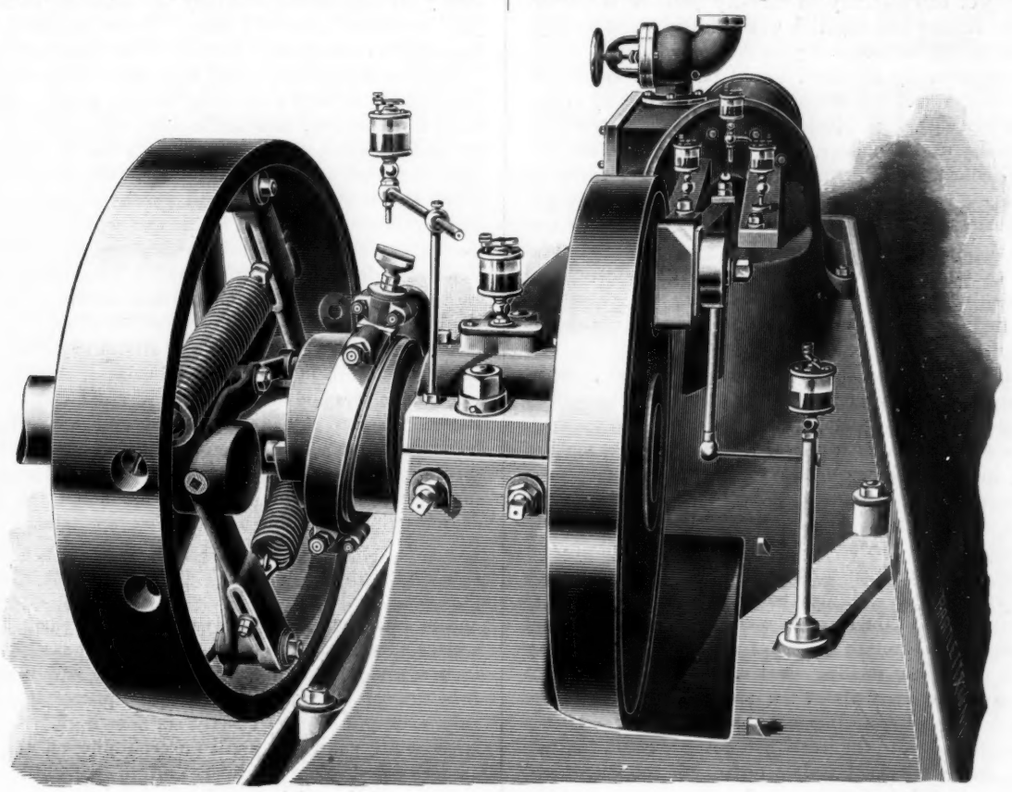


FIG 5.—See Page 9.

MACHINE SHOP AND FOUNDRY

WESTERN FOUNDRYMEN'S ASSOCIATION.

The regular meeting of the Western Foundrymen's Associatian was held Wednesday afternoon, Feb. 28th, 1894, at 225 Dearborn St., Chicago, the President, Mr. G. M. Sargent, in the chair.

The minutes of the previous meeting were read and accepted.

Messrs. F. W. Sargent, of Chicago, and A. K. Beckwith, of Dowagiac, Mich., were unanimously elected to membership in the Association.

Under the head of unfinished business, the following paper by Mr. E. A. Wheeler entitled, "Furnace vs. Foundry Practice," was read by the Secretary. It is in reply to Mr. Keep's criticism before the Foundrymen's Association, of Philadelphia, upon Mr. Wheeler's paper before the December meeting of this Association:

Furnace vs. Foundry Practice.

After reading the discussion at the December meeting, and Mr. Keep's paper on "Foundry Chemistry," I have concluded that the subject of chemistry in foundry practice is not exhausted, and further investigation would interest and perhaps be profitable to the members of your Association.

It is pretty generally admitted by all parties who have investigated this subject that silicon governs the quality of the iron in the castings. Mr. Keep says: "Silicon is the only thing necessary to the founder, as all other things in cast iron can be overlooked." He further says: "If we are correctly informed, these very furnaces have to ask a leeway of one per cent. of silicon on all contracts." If this is so, then all our theory of chemistry is good for nothing; for a variation of one per cent., either way, too much or too little, is enough to spoil any casting, and I wish to say right here that chemistry covering the analysis of iron, steel and ore in all their branches has been reduced to a science and is absolutely correct, and the gentlemen who follow the occupation take great pride in their profession. I have no doubt that analyses have been doctored to work off a bad lot of iron, but not by the chemist. I would as soon think of asking our bookkeeper to make a false entry in our books as to ask our chemist to give me a wrong analysis. That is the reason why I would recommend a chemist's card with each car of iron. I hope to show how this principle can be carried out and every foundryman can have all the benefits of a chemist without any extra expense to himself regarding the pig iron used. All the improvements and advances made in the iron and steel industry for the last 30 years have been through the aid of chemistry. Sir Henry Bessemer's process of making steel would never have been brought to perfection without the aid of a chemist, and in fact, was a failure without this aid; and this great discovery would have been lost to the world had not Robert E. Mushet, a chemist, suggested the burning out of all the silicon and carbon, then replacing sufficient carbon by adding just the right amount of high carbon pig, or spiegeleisen. This suggestion brought success out of failure and the greatest invention of modern times.

We often hear people talk about burned iron in the furnace and cupola, in fact one of our customers wrote us that "the last car of iron you sent us is not good; it was burned in the furnace, and the shipper knew it." The iron was very hot and the ends of the pigs where broken from the sow, were pitted with free carbon, a sure sign of good iron. In fact it is impossible to burn iron either in the furnace or cupola, for the reason that as soon as the iron is melted in either case it drops down through the cinder that floats on top of the iron, and is thoroughly protected from the blast and oxidation. Just a few weeks ago one of our largest consumers of iron told us something was wrong with our iron, that it did not hold out, seeming to be burned up in the cupola. Upon investigation we found his cupola working very cold. He had a large tap hole for cinder and it was very low and close to the iron. He was leaving it open, and a large volume of burning gas was escaping and a black, ropy cinder pouring out. The mystery was soon solved. The cinder tap was too low and had drained all the cinder off the iron, leaving it exposed to the blast and the iron was being oxydized and going off with the slag. We afterwards analyzed the slag and found that it contained over 22 per cent. of iron. It is a bad practice to tap out cinder too close to the iron, and unless you are melting a very large amount of iron at a time it would be better not to use a cinder tap; rather use a little less lime. Black glassy cinder, either from the blast furnace or cupola, indicates a cold furnace and that the iron and cinder are not separating.

Mr. Keep says: "It is not necessary to use high priced silicon iron, as any iron containing from 4 to 6 per cent. of silicon with phosphorus not over one per cent., is better." If an iron running from 4 to 6 per cent. silicon is not high priced, I do not know what is. I do not know of any furnaces offering iron as high as 6 per cent. silicon; in fact iron containing 7 per cent. or over is no longer called iron but is known as ferro-silicon and is mostly imported. If an iron running one per cent. in silicon is worth $10 per ton, then iron containing 6 per cent. silicon should be worth $16 per ton, because it will cost very nearly that much more, it requiring at least 1,000 lbs. more coke to make the 6 per cent. than the 1 per cent. silicon, the furnace being so much hotter is more liable to hang and slip and make less iron. Then, too, it is very hard to keep a furnace on that grade of iron, and I do not know of anyone making it. The American Scotch irons do not average over 3 per cent. silicon and they are used for softeners. A 3 per cent. silicon iron will carry its own weight in scrap and make good castings and even more if you want strong castings.

It is very true, as Mr. Keep says, that "it would not pay a foundryman to keep a chemist," for the reason that a laboratory is expensive, and to be kept in order should be in constant use, and as they would not have the work it would soon run down and not be fit for use. Mr. Keep further says: "Any forehanded founder will purchase large quantities of pig iron when the market is low and will not have room to keep a record of where each car is placed even if it were desirable to do so." On this question I am ready to rest my case. If it is a fact that foundrymen cannot, or will not, pile their iron so that they can keep a record of each car load that comes into their yards, then chemistry or any other system of order is a failure in the foundry business, and they have no use for analyses and must continue in the old rut. The writer has been in a great many metal yards and must admit that he has never seen a well-kept, orderly yard about a foundry, as most of them are a conglomeration of confusion, a receptacle for everything not in immediate use about the place. But cannot this be remedied now that we are talking of reform? Suppose, for example, we get a car of 20 tons, guaranteed to run 3 per cent. silicon, which we wish to keep separate. The pigs are 40 inches long (this being about the average length) and we find some place handy to the drive, where we can clean a place 4 feet wide and 12 feet long, and start 3 piles, each 40 inches square, crossing each layer. We will find when we have the car unloaded we have three piles stacked neat and tidy, each pile almost exactly six feet high. Now we take some white paint and mark on each pile on the face of a smooth pig the date of invoice and the percentage of silicon, and the job is finished and that lot of iron will never get mixed with other iron until the last pig is used. We get another lot and treat it the same way and so on, would not the yard soon get in good shape? If the iron is broken pile it the same way; you will have more piles but it will take no more room. You will soon find room is getting plenty. Now in regard to scrap. I would build a plank wall along side the drive or scale 5 feet high, 20 feet long, and always throw the scrap over the wall, and work from each end. This will always keep the side next the scale or road in good shape. This would be better than a plank box. Now that we know the silicon contained in the pig iron on hand the only question is, what does the scrap carry? Scrap does not vary in silicon like pig iron. It seldom varies over one per cent. Stove plate and light scrap will run about 2 per cent.; good machine scrap 1½ per cent.; car wheels, plow castings, etc., 1 per cent.; charcoal scrap about 1 per cent. In making up the heat we would have to make some allowance for the kind of scrap which would be used. If we want to be very particular, the man selecting the scrap will use a small hammer and hit the scrap and he can tell whether the silicon is high or low. If the scrap gives a sharp, hard ring the silicon is low, and vice versa. Now with our pig iron in the yard and knowing just what it runs in silicon, and knowing so near what our scrap

carries, would there be any trouble in telling how to make a mixture running 2 per cent. for stoves or 1½ per cent. for machine work, and 1 per cent. for plows and close castings? Now is the time when Mr. Keep's test bars would come in. Try the mixture and when you have it just right for your purpose you can rely on the same castings until the stock is all used up. We believe in the test bars, provided they are used in connection with chemistry; and we hope some day to have a small cupola and testing scales in connection with our laboratory.

There is quite a difference in opinion about the effects of sulphur in foundry iron. Some contend that a small amount of sulphur increases the strength of the iron. A car wheel made from coke iron, running ½ or 1 per cent. in silicon, would chill and be equally as hard as one made from the same grade of charcoal iron; but owing to the sulphur if it did not break in cooling, it would with the first rap it got, proving conclusively that the difference in the strength of the two irons is caused by the difference in the sulphur they contain. The sulphur in coke iron comes mostly from the fuel. Charcoal being free from sulphur, we get a low silicon iron free from sulphur, and a strong iron for car wheels, rolls, etc. It has been quite a mystery among furnacemen why high silicon iron should be low in sulphur and low silicon iron high in sulphur, all made from the same stock and perhaps the same day. It is the opinion of the writer that all iron as it runs from the furnace, made from the same stock, contains about the same amount of sulphur. The high silicon iron is always very hot and remains fluid a long time, and sulphur being very volatile escapes before the iron cools and leaves a smooth face on the pig; while low silicon iron comes from the furnace cold, and chilling as soon as it can be got in the beds and before sulphur has had time to escape. The evidence of this is that in high sulphur iron the top or face of the pigs are always honeycombed and have a pock-marked or rough appearance showing that the sulphur gases were escaping when the iron chilled. Another evidence of this is that we find the top of the iron contains more sulphur than the bottom of the pig or middle, showing the sulphur was caught by the iron chilling before it had time to escape. Would not the same principle hold good in the cupola? If so, melt your iron hot.

Mr. W. M. Moore, Joliet, Ill.: There has been a good deal of criticism upon Mr. Keep's statements regarding chemistry. He has, I think, occupied a unique position among foundrymen for some years and has been quoted both here and abroad. He has tabulated his experiments, and has gotten data which I doubt anyone else has from the same number of experiments. He has apparently exhausted one phase of the question—physical test—and I have always heard his opinion regarding foundry work quoted with the greatest respect until he began to attack the chemists. In doing that he has raised somewhat of a tempest in a tea-pot—in rather a large tea-pot. One of the trade papers within the last week contained an article from some English society of engineers or chemists, in which Mr. Keep was considerably criticised for his position regarding chemistry and the statement that chemistry and the foundryman had nothing in common; and especially his reference to silicon as being the only element which one had to take into consideration in working pig iron, and his statement that sulphur in the quantities in which it appeared originally in cast iron was of no significance. I think Mr. Wheeler's criticism is very good and such experience as we have had certainly bears out his statements. It is not a difficult thing for a foundryman to classify his stock and use it intelligently; all it requires is the disposition to do so. The statement that he makes regarding sulphur in the iron, and the use of slag and its influence upon the sulphur in the iron, is one that is new to me, but it seems to me that there is a great deal in that. He states that one of his customers was turning out twenty or thirty per cent. of iron which was running into the slag. If that is possible, it is a thing for which we should all watch out. I was not aware, before this statement was made, that this state of things could exist. Some of us may be slagging our cupolas at very great expense.

Mr. A. K. Beckwith, Dowagiac, Mich.: The idea that slag contains iron is a new one to me and a very valuable one, too. I had never thought of it. I have noticed that our slag is sometimes of a very dark color. I shall look into the matter more closely in the future.

Mr. L. L. Graves, Streator, Ill.: I have not had a great deal of experience. I have always thought in melting very dirty iron, that we had better results in melting it very hot. It is news to me that slag carries off as great a per cent. of iron as has been stated.

Mr. J. H. Whiting, Detroit, Mich.: I have used a physical test for a great many years, and I never found a very great loss of iron. The loss would average up about 3½ per cent., and I always took it for granted that that was a satisfactory result. I have melted 80 to 90 tons per day and kept the record for four or five days. The way we got at it was this: we kept an accurate record of the iron melted in the cupolas and at the end of the year took the sales and account of stock on hand. I never discovered there was very much loss—not more than 3½ per cent.

Mr. Beckwith: Our cupola is sometimes run through the heat without slagging. My idea from the paper is that the slag is run off close to the iron and exposes the iron.

Mr. Moore: In our case we have a slag-room that is low and it is possible that we are doing, without knowing it, the very thing that this man was doing.

Mr. H. S. Vrooman, Chicago: Mr. Keep must at some time have employed a chemist. Without it he could not give the points he does. I do not see why he should go back on the chemist.

Mr. Sargent: Mr. Keep thinks it would not pay to keep a chemist in the foundry as a general thing—he does not seem to condemn the chemist.

The Secretary then read the following paper by Mr. Simpson Bolland:

A Foundryman on Foundry Chemistry.

An article of mine on "Mixing Cast Iron," that appeared in issues of March 24 and 31, 1892, of the *American Machinist*, and which now constitutes the third chapter in my book, "The Iron Founder Supplement," was the natural outcome of experiences therein related. It was with some trepidation on the author's part that the article was presented, as at that early period of my experience in these matters I hardly felt able to adequately exhibit a subject which, to me at least, appeared in the light of a revelation.

The article met with a determined opposition from some quarters, both here and abroad; but I shall ever esteem the kindly criticism of Prof. Torrey, who, while admitting that science must, for some time at least, get the lion's share of the benefits accruing from a system of chemical analysis in the foundry, thought the establishment of laboratories, and the installation of chemists in that department of the iron industries, would be a very good thing. He concludes a very instructive review of the subject as follows: "I have no intention of trying to instruct Mr. Bolland, or any other foundryman. I have simply called to mind a number of facts with which they are, presumably, as well acquainted as I am—better, perhaps, with one side. The only object in so doing is to put the question of chemistry in the foundry in its proper light with relation to existing facts. Perhaps the foundry at large, from a business point of view, would be benefited by the co-operation of the chemical laboratory, but I do not as yet believe it. . . . The foundry has not the great train of waste and by-products that many industries have, and the waste, such as it is, can be better controlled. The one place where it would seem that chemistry might come in would be in the mixing of irons, as Mr. Bolland suggests; but, as previously stated, it is by no means certain that anything definite or satisfactory would be accomplished." Since then, however, a gradual change has been taking place, and an eminent metallurgical chemist, Mr. Clemens Jones, emphatically states that "the foundryman is in a position to say to the pig iron maker, 'I want such a quality of iron,' and the furnace manager is in a position to light his fires and make it."

With such assurance from one so conspicuously qualified to pronounce an opinion on such themes, may we foundrymen not anticipate the time when, by reason of a superior education, we shall be able to exactly determine our requirements, and prove beyond question the validity of such an assertion?

We who are not chemists naturally cling tenaciously to the only tangible support that, up to the present, has been vouch-

safed us, viz.: the testing machine; and I am persuaded that it will take some time to convert the large majority of founders to a belief in this (to them) new departure. My first acquaintance with this subject dates from the time when I was associated with Mr. Molin, metallurgical chemist, New York City. At that time I looked upon the faculty as a decided superfluity in a foundry, but it gives me pleasure to say that, while he noticed my self-assurance, he consistently acted, not only the scholar, but the gentleman. He also unmistakably demonstrated his ability to accomplish, by chemical analysis, what had before seemed impossible of accomplishment; and, while he may not have made a chemist out of such crude material, I am certainly a sound convert to the methods of which he is so able an exponent.

A careful perusal of Mr. Keep's able papers and other kindred works, as well as the exhaustive productions read before this and the Eastern Association by our foremost chemists, has established my belief beyond question. Mr. Henderson, in his address before the Foundrymen's Association, of Philadelphia, brings this whole subject out in bold relief when he says: "But what of permanent avail is accomplished by the application of physical tests to material the chemical composition of which is unknown? The very utmost that can be hoped from such tests is to establish the fact that a definite lot of material is either good or bad."

The above is preceded by a forcible plea for the recognition of chemistry as a factor in foundry practice on the following grounds: "That, whereas it is known that certain impurities in material produce certain characteristic effects upon the physical behavior of manufacture resulting from its employment; that certain combination of impurities produce certain other effects, and that in the process of conversion, which is in every case a chemical one, these impurities may be eliminated, retained, or forced into combination with others according to fixed laws and conditions to which they are subjected." But he further affirms that in order to secure a proper adjustment of these proportions, so that the resultant casting shall meet all the requirements in the case, ability of the highest order must be employed, simply because the line is not so clearly defined, on either side of which an element may not enter into its composition without disaster.

The same author comparing the value of chemical against physical tests affirms that, "A fact once established by chemical research remains fixed for all time. When it is known that a certain percentage of an element in a material under certain conditions produces a certain physical effect, every time these conditions are reached in this material having the same percentage of the element this identical physical effect is obtained and no other."

Mr. Keep claims that "Intelligent mixing of irons cannot be accomplished without the aid of chemistry, and conclusions must be reached by the united work of chemistry and physical experiment." That the time is not far distant when the chemist will be acknowledged as the supreme factor in foundry economics is significantly put by the same author, who on this phase of the subject says: "If a man with a thorough chemical education would learn to look at general tendencies and not hold so closely to four figures of decimals, and accept the results of late research, he could adapt himself to general foundry work and be of great use. He would soon leave his laboratory and become the practical leader, and would only go back occasionally to solve some problem that needs new light. We cannot have too much respect for chemistry. Practical research could do nothing without it; but after general conclusions are reached, then to be of use the chemist must become the practical metallurgist."

On this head, Prof. Torrey cogently informs us that "it takes the skilled metallurgical engineer to reason from the chemistry to the physics of iron; and the chemist must be a good one if the results are to be good for anything."

It may be readily inferred from the preceding that the chemist's work in the foundry must be practical in all its bearings, and that a mere school knowledge of the science would be of little service there.

Subjects like the porosity of castings, cast iron and steel, would, under the supervision of a chemist, be subjected to a superior system of examination; even the ordinary crucible tests would receive his strict attention, with the positive assurance of their being made intelligently. Metal mixing would be transferred from the ignorant mechanic, with his crude systems, to the more positive and scientific methods of chemical research; just where it should have been long ago. For the want of intelligent direction the best systems of mechanical testing have always been more or less defective; and as matters now stand, formulas of any kind are seldom understood, and as seldom acted up to; the chemist would change all this with the greatest ease and dispatch. The business of steel founding would have developed more rapidly if the chemist had been consulted with regard to the materials for forming the moulds as well as for the metal with which to fill them. Brass founding is almost exclusively a branch of metallurgical chemistry; and it is safe to say that the few advances made in that art have emanated from the chemist's laboratory, rather than the brass shop.

There is nothing used in a foundry that does not require rigid inspection when purchased, such as an able chemist only can give; and it would be to the interest of every firm that not only the iron, but fuel, sand, fire bricks, clays and every material employed should undergo close scrutiny; by this means all fraudulent impositions would be at once detected. Already we may observe that sands for foundry purposes are receiving some attention from the chemist.

Analysis at once discovers just what may be used for the numerous classes of castings made. We may expect to be informed that in the great majority of cases we have been unnecessarily annoyed by the presence of elements unfavorable to the production of good castings, when, perhaps, a more suitable material has been overlooked that might have been employed with impunity at a much less cost. The percentage of iron oxide, alumina, organic and volatile matters present being made known, there will be no difficulty in making such selection as will meet every requirement absolutely.

It is reasonable to presume that the advent of a chemist in the foundry will deter the artful agent from forcing material upon a firm that did not in every respect measure to the full what it was represented to be, and it is certain that the popularity of many favorite irons would go up with the smoke from the laboratory when a test in the latter sanctum had revealed its marked deficiencies.

Fracture will no longer be relied upon, as it is now a well authenticated fact that analysis has shown that very many of the No. 1 irons are inferior to No. 2 of other brands which may be purchased for less money, saving, in many instances, from 50c to $1.50 per ton.

There can be no question as to how some of our foremost firms are producing castings for such low figures at this time. To my personal knowledge, analysis of the materials employed is at the bottom of it, for, by reason of the knowledge thus obtained, they have been enabled to purchase both pig iron and scrap at ridiculously low figures, very much of which, under the old rule of thumb methods, would have been rejected as unfit for the purpose. In many instances this decided advantage has been further supplemented by the production of better castings.

It is certain that those who buy on analysis, knowing what they want, monopolize every opportunity for grabbing whatever offers cheap, as the chances for future disappointment are reduced to a minimum by the substitution for the old unsafe method of one that is not only cheap, but sure.

There is practically no difficulty in producing steel of any desired quality, owing to the fact that the different elements are now so well known and may, by chemical test, be regulated in such proportions as will result in the quality of steel required. To accomplish this without loss and inconvenience, all the material is tested before purchase is made and the user knows exactly what he has bought and can, without fear of mistake, proceed to the manufacture of his product, knowing from the beginning what the end will be. Surely castings, pig iron and scrap, can be analyzed with as great nicety so that when fault is found with the resultant castings, the true cause of the trouble may be located, the mixture changed to the requisite proportions and thus control the business as effectually as it is now done for steel. In framing mixtures for cast iron, it must naturally occur to the least observant that if a certain proportion of the elements contained in the iron produce certain chemical effects, which, in turn are productive of certain physical properties which may be altered according to the proportions employed, we are forced to the

conclusion that chemical analysis will reveal whatever is lacking and will also suggest a remedy.

A defect in some pump castings resulted in an analysis of the iron being made by Mr. Molin, who found that it was too high in graphitic and correspondingly low in combined carbon, which caused a soft, porous iron that would dissolve rapidly in the water from the mine. This discovery led to an immediate change in the mixture, an additional quantity of combined carbon effecting at once what under the old regime would not have been satisfactorily accomplished until the offending stock had been all used up and a change brought about, perhaps, by a new consignment. The latter alternative is, unfortunately, the only means of escape possible for numbers of foundries to day all over. Desiring to learn more in reference to the above, I waited upon the superintendent of the firm who informed me that an elaborate system of physical tests were the order of the day, and that unremitting attention was paid to this department, but he was now firmly persuaded that unless this was accompanied by chemical analysis they would always be subject to a like experience.

Personally, I may state that since I became satisfied in reference to the wonderful property of silicon to change white and intermediate grades of irons more or less high in combined carbon, into graphitic iron, I have experienced no difficulty whatever in arranging my mixtures, simply because a physical test informs me of its strength, and, if the shrinkage is found too high, it is evidence of hardness, which latter condition I now know may be lessened by an increase of silicon, the shrinkage always decreasing in proportion as the iron becomes more graphitic.

It is not supposed that the common run of small foundries will employ a chemist, but if it be found in the long run that the system of analysis pays, there is no question but that they too will contrive some means for obtaining these valuable aids. For instance, proprietors' sons who have hitherto been satisfied with the regular routine of office work, will now have their ordinary course of education supplemented by a course in metallurgical chemistry, and thus qualify themselves for the position of chemist, as well as clerk.

A chemist lately said that the reason of foundrymen remaining in the blindfold state they are, is simply their ignorance of the fine elements which determine the quality of their castings, and furthermore, that this knowledge can be easily obtained by any intelligent clerk, who may then with an outfit, costing about $200, proceed to make tests for these elements as satisfactorily as any chemist.

One thing, however, is certain: our young men are gradually awakening to the advantages open for students in the technical schools, and, as chemistry is taught at most of them, we may expect in the near future to see our benevolent employers rendering substantial aid to their apprentices, in order that they may be qualified for the important duty of making an analysis.

Why is it that our technical schools stand aloof from this all important question? Is this, like everything else pertaining to the foundry, to be tabooed also? Have molders and founders no rights that these institutions feel bound to respect? Surely the day is now past when a foundryman is to be spurned because of the apparent griminess of the business. I think the advent of chemistry in the foundry will mark a new era in the history of foundrymen; hitherto the faculty have shunned them on account of their surroundings, but the rays of science have penetrated the dark molding shop at last and her votaries hasten to undo the errors of the past, because, discerning the numerous problems that remain as yet unsolved, they have finally cast prejudice aside and are now walking hand in hand, the more practical molder being guided by the scientist in paths that harmonize with physical law.

Your true man of science now acknowledges freely that the foundryman is deserving of more than ordinary credit in that so much has hitherto been accomplished by men who were shrouded in such a dark panoply of ignorance.

It is to the truly great amongst these men of science that the future founder must look for enfranchisement. Let furnaces and the necessary equipment for the smelting of ores, metals, alloys, etc., be at once erected in our technical schools where our aspiring youth may be taught experimentally how to eliminate the objectionable elements from metals, also to determine by analysis of materials, including fuel, slags, ores, fluxes, etc., what their natures consist of and thus qualify themselves for the very excellent change in their position, which to me seems inevitable in the near future.

Mr. McKenzie, Chicago: My own experience of four or five years in the Illinois Steel Works, where every piece of material coming in and going out was subjected to analysis, makes me think that it would be of benefit to the foundryman as well. On one occasion in the making of steel castings, the addition of .25 per cent. of silicon obviated all the difficulty that the foundry was experiencing in making the castings. Their castings were perfectly satisfactory except that they did not do the work they were called upon to do. They leaked right through the body of the metal. We found by changing the mixture in the cupola we had a good sound casting and it did the work well, that it was called upon to do. We analyzed the casting which was defective and suggested the addition of silicon and a few other practical methods of treating the metal after it was melted, and then it did the work.

Mr. Moore: May I ask if the trouble was in pipe fittings?

Mr. McKenzie: Yes, sir.

Mr. Moore: Was the trouble where there was a joint?

Mr. McKenzie: No, it was right through the body of the casting. The casting was porous and the pressure pushed it right through.

Mr. Beckwith: I want to say in regard to finding that a No. 2 iron of some brands works better than a No. 1 of some other brand, that we have noticed also. We have bought a strong iron with a beautiful fracture and could not use it at all. We have used No. 2 and No. 3 iron that would be better than this No. 1. If you were buying iron on fracture you would buy that every time. No. 2 and No. 3 have close fracture, not so fine to look at, but made a better iron.

Mr. W. H. Fenner, Chicago: I would like to ask what suggested to the gentlemen to use more silicon?

Mr. McKenzie: We found that the high silicon steel lies quieter in the molds.

Mr. Fenner: My experience is that addition of silicon to the iron makes it more open. I do not know how it would be with steel.

Mr. McKenzie: You have a great deal more carbon in the iron to change to graphitic. In steel you have very little carbon. Iron may contain from 2 to 3 per cent. and steel may contain only .01 per cent. Soft steel with low silicon is very hard to keep quiet. It is very pourous.

Mr. Fenner: If it was iron you would have reduced the silicon instead of adding it?

Mr. McKenzie: Yes.

Mr. Moore: The paper testifies to a belief of the value of the laboratory as an aid to the foundry. I am certain of it. Speaking of the use of No. 2 iron—that is of a higher grade iron being of less value than a lower grade iron—I have some analyses here of some Southern irons which may be interesting:

	No. 1 F'd'y.	No. 2 F'd'y.	No. 3 F'd'y.	Soft Iron No. 2.	Gray Forge.
Silicon.....	3.1	2 5	2.3	3.5	2.
Sulphur...	.068	.005	.008	.009	None.

I have also these other analyses:

	No. 1 Soft.	No. 2 Soft.	No. 3 F'd'y.
Silicon.....	2.69	2.76	2.9
Sulphur.....	.013	.016	.022

Now if silicon means anything in iron it means that the No. 3 iron is softer than the No. 1, for, although there was a difference of perhaps .8 per cent. in silicon in favor of No. 1 it contained nearly ten times as much sulphur. Comparing the No. 3 with No. 2 soft we have about 1 per cent. additional silicon but exactly the same sulphur. Again comparing the No. 2 soft with the No. 1 foundry we find that there is no very great difference in the silicon—3½ against $3\frac{1}{16}$—but the No. 1 foundry contains eight times as much sulphur. I believe, and I am willing to buy iron on that belief, that if I pay five cents more a ton for No. 1 soft than I do for No. 2 soft—I do not care what the fracture of the iron is—that I am just paying five cents too much.

You will see from the last analysis that the No. 3 foundry contains more silicon than either No. 1 or No. 2 soft and that there is no appreciable difference in sulphur. It runs higher in silicon by .14 per cent. than the No. 2 soft. I am satisfied that the No. 3 foundry having that analysis will be just as

strong when remelted as the No. 1 or No. 2 soft, even a little stronger, because it has a little more silicon in it. The more experience I have the more confidence I have in buying iron on analyses. We are confined to a certain line of work. Our experience would probably not be of value to any others, and if we were called upon to make a cylinder or a car-wheel we would not feel as though we could rely upon our own knowledge. For the purpose for which we use iron—stove castings—we feel reasonably safe to buy upon analyses.

Mr. Vrooman: In Mr. Bolland's article I think he speaks of the fuel, sand and fire-brick. Very few foundries make analyses of their sand. It is more a question of price than anything else. Does not the sand absorb the impurities from the water, blacking, etc., and does not the iron take up these from the sand? I think that in depending upon the analysis of iron alone we make a mistake.

Mr. MacKenzie: I quite agree with the gentleman that there may be a large number of impurities in the sand as commonly used. We used to pay a great deal of attention to our vessel-lining sands. I presume the same thing would be necessary in molding-sand.

Mr. Vrooman: Does not the sand absorb the impurities that come from these sources?

Mr. MacKenzie: Yes, undoubtedly the properties of the water on evaporation remain in the sand.

Mr. Vrooman: Could there be enough of this to have any effect on the iron?

Mr. MacKenzie: Not materially. After a time it might. Impurities in water, while largely looked upon as impure water, would be small after the evaporation. As time went on they would, of course, accumulate.

Mr. Fenner: It has a great effect upon the iron in the cupola. Whether the iron absorbs the silicon from the molds I have never tried to demonstrate.

Mr. MacKenzie: I do not think the iron would absorb any silicon from the sand in the molds. You have got to have a certain temperature to make the combination possible, and you do not get to that temperature in molding.

Mr. Vrooman: I mean the impurities the sand would absorb from the plumbago, carbon, etc.

Mr. Fenner: I would say that the iron being chilled would not absorb any carbon.

Mr. Moore: Cast iron is reasonably saturated with carbon. Is it possible to absorb more carbon?

Mr. Vrooman: It does not absorb the carbon. Does the sand absorb the impurities? That is the question. If the sand absorbs the impurities, does the iron take them from the sand? Mr. MacKenzie said that the water would in time take up the impurities.

Mr. MacKenzie: You must understand I spoke of the theory. The theory is that in the course of time these impurities would accumulate. I know the impurities are very minute.

Mr. Moore: The suggestion of the action of water upon sand has occurred to me because, for a great many years we have been using water which is highly charged with lime and the thought has occurred whether or not the constant use of the lime water is not affecting the sand. Whether or not it is I really don't know but I think the suggestion is one that is worthy of consideration and it is quite possible that the use of water that is highly charged with lime, sulphur and other substances might be injurious.

Mr. Fenner: Do you not think that lime injures iron?

Mr. Moore: I have never seen anything to indicate that.

Mr. Beckwith: We made a series of experiments in lime and were not able to see any particular difference either in the strength or softness of the bar.

Mr. Fenner: If it does not injure iron why does it injure water?

Mr. Moore: My suggestion was that it injured the sand.

Mr. Vrooman: The lime is used as a flux and I should think the lime flows off with the slag and is not melted. It does not come in contact with the iron.

Mr. Beckwith: In charging lime for the flux we would charge it on the iron as it is melting. It collects the dirt from the iron and flows off.

Mr. MacKenzie: Lime does not combine with metallic iron at any time. It forms a silicate of iron which goes off as slag.

Mr. Fenner: Has any one ever had any experience with high silicon iron cutting his furnace lining any faster than iron with low silicon?

Mr. Moore: We never observed any difference. We only make small castings, and use iron which is fairly high in silicon. At the same time our lining lasts about as long as that of any foundry that uses a mixture of one per cent., or more than that, less in silicon than ours.

Mr. Fenner: I have found where we use the iron high in silicon it cuts the lining out.

Mr. Moore: I don't see why.

Mr. Fenner: It forms an acid.

Mr. Moore: I don't see why the presence of the silicon in the iron should affect the silicon in the lining. Do you reduce your silicon much in the high silicon iron?

Mr. Fenner: I use it more for taking up slag.

Mr. MacKenzie: Do you get a very black slag?

Mr. Fenner: Yes, it is heavy.

Mr. MacKenzie: It forms a silicate of iron, the oxide of the scrap combining with the silicon.

Mr. Fenner: My experience has been that there is much more to be gained by using low grade iron than by working high grade irons. I do not get as good results in high grade irons as I do in low grade irons.

Mr. Moore: There may be a great deal of truth in the statement of the paper, that when all foundrymen can intelligently adjust their purchases to their wants, as determined by analysis, some of the furnaces will find their peacocks are nothing but common fowls.

Mr. Gardner: How do most of the furnaces grade their iron, by fracture or chemical analysis?

Mr. MacKenzie: Foundry iron by fracture; Bessemer by analysis.

Mr. Gardner: Some of them give a chemist's card with every car.

Mr. MacKenzie: There are analyses made of all casts. Some purchasers do not care for the analysis and buy from their experience by the fracture. They see an iron that suits and they buy it.

Mr. Vrooman: Do test bars under the same heat break at the same pressure? Does it not always take three to get an average?

Mr. MacKenzie: I think it does.

Mr. Vrooman: Do they not always vary?

Mr. MacKenzie: Yes, they always vary somewhat. You never get two samples of anything that are exactly alike.

Mr. Moore: In blast furnace products is there any uniformity in the castings in the different parts of the heat?

Mr. MacKenzie: The flux running hot reduces more silicate to silicon, and the slag takes off more of the sulphur and generally there is more silicon than sulphur at the latter part of the heat.

Mr. Moore: But as the iron lies before it is tapped you have a mass of metal which is permeated with the sulphur.

Mr. MacKenzie: The temperature at the time of the iron being formed is the temperature which would apply to each cast. After the iron has been made and is lying in the bottom of the flux it does not go through much change.

Mr. Moore: The condition at the end of the cast must be the same as at the time the iron is being tapped?

Mr. MacKenzie: Yes, sir.

Mr. Vrooman: I would like to ask if there is any difference in the bar whether it is poured with hot iron or with cold iron. When it chills down to the color of an orange or when it is white?

Mr. MacKenzie: I am unable to answer that question. I have not had any experience in that particular line.

Mr. Beckwith: I do not think there would be any particular difference. I have tried it both ways.

Mr. MacKenzie: Referring to the change in the quality of the metal, of course, one refers to a furnace that is working uniform. A furnace that is working off would change the iron entirely. You can see when it is poured out whether it has changed from the hot to the cold line.

A vote of thanks was unanimously extended to Messrs. E. A. Wheeler and Simpson Bolland for the excellent and interesting papers they had presented to the Association. The meeting then adjourned.

TROPIC furnace, Jackson, O., has blown out.

INDUSTRIAL SUMMARY.

New Enterprises :—

The following recent incorporations, specially reported for *The Iron Trade Review*, are of interest to the iron and machinery trades :

Philadelphia, Pa.—Domestic Supply Co.; capital, $100,000; for the manufacture of iron or steel or both, etc.; incorporators: Samuel H. Kemp, Wm. J. Ludden, Abram P. Bescherer. Address letters care of M. E. Olmstead, Harrisburg, Pa.

Janesville, Wis.—The Tuckwood Machine Co.; capital, $30,000; for manufacturing and dealing in engines, feed mills, etc.; incorporators: Wm. Tuckwood, C. H. Tuckwood, B. Benton. Address letters care of John Cunningham, Janesville, Wis.

Chicago, Ill.—Chicago File & Rasp Co.; capital, $6,000; orf the manufacture of files and rasps and recutting files; incorparators: Wm. Didriksen, T. Pierson, G. Larsen. Address letters care of R. S. Carroll, 4 108 Washington st., Chicago, Ill.

Troy, N. Y.—The Capital Cash Register Co., of Troy, N. Y.; capital, $125,000; for manufacturing cash registers; incorporators: S. B. Mount, Dagobert Zeiser, Troy, N. Y., Nelson Lyon, Albany, N. Y. Address letters care of Nelson Lyon, Albany, N. Y.

Racine, Wis.—Racine Hardware Co.; capital, $175,000; for manufacturing and dealing in articles made of iron and wood; incorporators: Chas. F. Hunter, L. M. Ogden, M. W. Sherman. Address letters care of Quarles, Spence & Quarles, Milwaukee, Wis.

Shickshinny, Pa.—The Shickshinny Tube Co; capital, $40,000; for manufacturing seamless drawn copper, brass and bronze tubing; incorporators: R. M. Tubbs, A. W. Stackhouse, J. M. Stackhouse. Address letters care of Isaac P. Hand, Wilkesbarre, Pa.

Dayton, O.—The Dayton Labeling Machine Co.; capital, $25,000; for the making and selling of machinery, etc.; incorporators: A. L. Stevens, J. M. Phelps, C. W. Uthbrok, John E. Weiffenbach, Walter F. Phelps. Address letters care of J. M. Phelps, Dayton, O.

Anderson, Ind.—The Springer Automatic Thrasher Co.; capital, $30,000; for manufacturing thrashers, stockers, separators, etc.; incorporators Wm. N. Springer, Wm. J. Woolley, Jas. F. Springer, Anderson, Ind. Address letters care of W. S. Shelton, Anderson, Ind.

Muskegon, Mich.—The Rich Frog Co.; capital, $50,000; to manufacture and sell the Rich Patent Railway Frog, and railway switches, etc.; incorporators: Edwin Rich, Harrison Rich, Wm. W. Barcas, all of Muskegon, Mich. Address letters care of Brown & Lovelace, Muskegon, Mich.

Grand Rapids, Mich.—National Machine Co.; capital, $25,000; to manufacture, sell or lease machinery, tools and machines; incorporators: Wm. E. Elliott, Grand Rapids, Mich., M. L. Elliott, Marion, Iowa, T. J. O'Brien, Grand Rapids, Mich. Address letters care of Thos. J. O'Brien, Grand Rapids, Mich.

Cincinnati, O.—The Randle Machinery Co.; capital, $50,000; for manufacturing and dealing in boilers, engines, saw-mills, injectors and machinery of all kinds; incorporators: Wm. Ritchie, Fred. Doeller, Thomas M. Randle, Wilber H. Murray, P. P. Hogue. Address letters care of W. J. Davidson, Cincinnati, O.

Erie, Pa.—Chicago and Erie Stove Co.; capital, $200,000; for the manufacture and sale of castings, stoves, heaters and any and all kinds of merchandise connected therewith; incorporators: Chas. M. Tibbals, Chas. C. Shirk, Frank C. Whitehead. Address letters care of S. A. Davenport, State and 7th sts., Erie, Pa.

Valparaiso, Ind.—The Valparaiso Mfg. Co.; capital, $10,000; for manufacturing clocks, watches, electrical instruments, tools, machinery and other products, of metal and wood; incorporators: Jno. W. Elam, Franklin S. Wenk, Grant Crumpacker, C. B. Woodard, Jas. W. DuLaney. Address letters care of E. D. Crumpacker, Valparaiso, Ind.

New York City, N. Y.—The Tadella Pen Co. (incorporated in W. Va.); capital, $500 min., $250,000 max.; for manufacturing Tadella alloyed zinc pens and other stationery, buying and selling same; incorporators: Franklin R. Wallace, Willis B. Richards, Edward Wickoff, all of N. Y. City, N. Y. Address letters care of Geo. C. Holt, 111 Broadway, New York, N. Y.

New York City, N. Y.—Sharp Cash Recorder Co. (incorporated in W. Va.); capital, $10,000 min., $720,000 max.; for manufacturing, selling, exchanging, repairing, etc., the Sharp Cash Recorder, etc.; incorporators: Jno. S. Wise, R. G. Day, N. Y. City, N. Y., J. H. McClement, Brooklyn, N. Y. Address letters care of Hon. J. S. Wise, 226 West 44th st., New York, N. Y.

New Buyers in the Market, and Some of Their Wants :—

[If you are in need of machinery of any description, please notify *The Iron Trade Review* and we will put you in communication with our advertisers at once.]

A. E. Alexander, High Point, N. C., is in the market for an engine and boiler.

Warner, Moore & Co., Richmond, Va., are in the market for woodworking machinery.

The Stonington Brick & Pottery Co., Natchez, Miss., is in the market for an engine.

S. B. McKinney, Farmville, Va., will buy ice manufacturing and cold storage machinery.

Street & Co., 184 Washington st., Chicago, are in the market for a three h. p. gas engine, second-hand.

The Mattoon Mfg. Co., of Sheboygan, Wis., will contract for two 400 h. p. engines and a 250 h. p. boiler.

F. P. Arbuckle, 5 Granite bldg., Denver, Col., is in the market for a pumping engine and machinery.

The New Castle (Pa.) Water Co. will be in the market in a short time for new pumping engines and machinery.

Spencer Hall, of Racine, Wis., is purchasing machinery for a bicycle works to be located in that city. A plant will be equipped for turning out high grade wheels.

The Shultz Mfg. Co. was organized at Pottstown, Pa., March 2, with G. F. Rotheacker, Jr., of Philadelphia, as president. It will manufacture locks. Employment will be given to 150 hands.

The Southwestern Bridge & Iron Co., of Fort Worth, Tex., is rapidly placing its works in shape for business. It is in the market for a second-hand pair of 8-foot bending rolls with capacity to bend up to ⅞-inch plate.

The Wiggins-French Engineering Co. have leased the Brodie Foundry at Little Rock, Ark., and will engage in a general foundry and machine business. The members of the company are C. P. Wiggins, Jr., M. H. French and R. W. French.

The Minthorn Emery Co., of Homer, N. Y., whose office address at present is 140 Groton ave., Cortland, N. Y., will buy chucks, conveying machinery, elevators, lathes, pulleys, hangers and shafting, wheelbarrows, ore crushers and granulators, washers, concentrators and sieving machinery.

At the office of the Supervising Architect, Washiugton, D. C., sealed proposals will be received until 2 P. M., March 29, 1894, for furnishing and putting in place complete the first story columns and the second floor beams and girders in the U. S. postoffice, court house and custom house at St. Paul, Minn.

New Construction :—

Chas. W. Reynolds will start a new foundry at Champaign, Ill.

At Akron, O., John Everhart is about to erect a new machine shop and foundry.

The Putnam Foundry & Machine Co., of Putnam, Conn., will build a new warehouse and pattern shop.

Miesser Bros., Huntingburg, Ind., will shortly erect a 50x100 feet building to be used as a foundry and machine shop.

The Shiffler Bridge Co., of Pittsburg, have received the contract for a steel roof to cover the machine shop of the Brooks Locomotive Works, Dunkirk, N. Y.

John H. Bass, of Ft. Wayne, Ind., has completed an extensive car wheel works at Lenore, Tenn., for supplying the Southern trade. Foundry and finishing shops will employ 300 men.

The Columbia Corrugating Mfg. Co., Niles, O., have completed the erection of a factory 60x200 feet, fitted up with improved machinery. This addition will considerably increase their capacity.

Work on the new plant of the Baker Forge Co., of Ellwood City, incorporated for manufacturing drop forgings and wagon hardware goods, will begin this week. It will be put in operation as soon as possible.

The Emlyn Iron, Steel & Tin Plate Co., Summitville, Ind., have begun work on a plant which will give employment to

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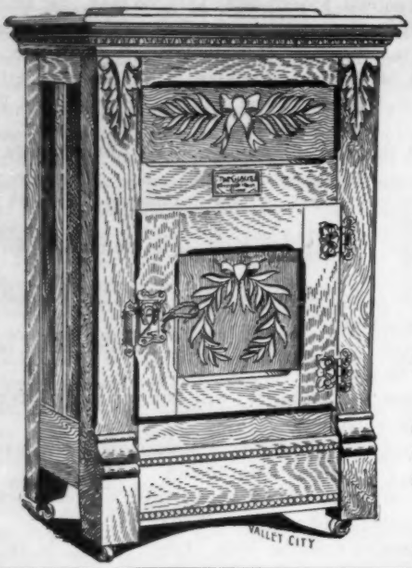

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about 350 men within six months. The Big Four railroad has begun the laying of sidetracks.

The Reese Iron & Steel Co., Tonawanda, N. Y., are about beginning work on their plant, which will cover eight acres and cost $100,000.

Heath & Sons have completed a new foundry at Lestershire, near Binghamton, N. Y. The foundry is 120x40 feet in size, two stories high, and has been built as an addition to their wood working machinery plant.

The Shiffler Bridge Co. has secured the contract for rebuilding N. E. Whitaker's Crescent mills at Wheeling, destroyed by fire about four months ago. The new mill will be built entirely of iron and completed in about 80 days.

Additions, Enlargements, Removals, Etc.:—

A contract has just been closed which insures the removal of the Schackleton Steam Radiator Co. from New Jersey to Alexandria, Ind. A new company will be formed with a capital stock of $25,000.

Kirkpatrick & Co., the Leechburg, Pa., sheet manufacturers, intend to build a small mill adjoining their big plant for the manufacture of Russia iron. They have a process which is said to be revolutionary.

The Diamond Steel Co., Reading, Pa., are erecting an addition 60x175 feet, to be equipped with hammers, two complete trains of rolls, one 12-inch and one 14-inch, and other machinery costing $20,000. This will more than double their capacity.

Fires and Accidents:—

The machine and repair shops of the Standard Oil Co., at Buffalo, burned with $20,000 loss.

The machine shop of J. L. Brown, at Reed City, Mich., burned. Loss, $3,000; uninsured.

Rose & Co.'s extensive machine shops at Washington, Pa., were partly destroyed by fire, March 1.

The works of the Connecticut Mfg. Co., at Cenbrook, Conn., manufacturers of augers and bits, burned with $40,000 loss.

The warehouse of the machine works of Hess, Snyder & Co., at Massillon, O., burned, with valuable patterns. Loss, $5,000 to $6,000.

Fire in the Bloomington, Ill., Stove Works, Feb. 25, caused $15,000 loss, almost completely wrecking the building and destroying patterns and considerable new work.

At Furnace C, Braddock, Pa., an explosion last week fatally injured one workman and severely burned others. The furnace was badly damaged. The breaking loose of a quantity of metal that had been hanging caused the accident. A more serious explosion occurred at Furnace C several years ago.

General Industrial Notes:—

The Lehigh Valley foundry at Hazleton, Pa., has resumed operations with a full force of men.

The Laughlin Nail Works, at Martin's Ferry, O., resumed in full this week after a long shut down.

The Spang Steel & Iron Co.'s plant at Etna, Pa., resumed March 5, giving 150 men employment.

All the puddling furnaces at A. M. Byers & Co.'s plant, Pittsburg, are in operation at the $4 rate.

Isabella Furnace No. 3, at Sharpsburg, Pa., started up Monday, after being banked for several months

The steel mill at New Castle, Pa., broke the record last week by making 714 tons of steel billets in two turns.

J. H. Eller & Co., of Canton, O., have brought out a number of novelties in roofing, patented by the head of the firm.

At the Canton Wrought Iron Bridge Co.'s works at Canton, O., there is a goodly amount of work on hand and the outlook is encouraging.

Grace furnace, Youngstown, O., operated by the Brier Hill Iron & Coal Co., resumed operations March 1, giving employment to about 150 men.

Hoorn, Bergman & Co., of Fergus Falls, Minn., have begun to manufacture stationary engines in connection with their established foundry and machine trade.

Receiver Wm. Keenan, of the Troy (N.Y.) Steel & Iron Works, has resumed operations, on securing a large order for steel, and 125 additional men are at work.

The merchant mill of the Bethlehem Iron Co., which has been idle for several months, resumed operations Monday. All the mills of this company are now in operation.

The puddlers of the Penn. Iron & Coal Co., of Canal Dover, O., have accepted the terms of the company to work on the eight-hour system, and the plant is now running full in all departments.

The New Castle, Pa., Wire Nail Co. proposes adding to its equipment 12 double-header machines, which will increase the capacity of the mill 500 kegs daily, making the daily output 3,400 kegs.

Cooper, Hewitt & Co.'s employes in the new Jersey Steel & Iron Works, Trenton, N. J., have been cut 10 per cent. where their pay was over $1.25 a day, and 5 per cent. where their pay was $1.25 or less.

The Lehigh Valley Railroad shops at South Easton, Pa., which have been working but four days a week for several months, were ordered on full time March 1. Over 600 men are employed in the shops.

The Harlan & Hollingsworth Co., Wilmington, Del., have obtained the contract for doing the machine work on the

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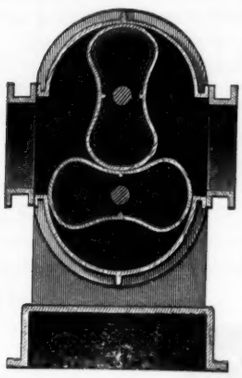

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CINCINNATI, O.

"THE IRON TRADE REVIEW" is an increasingly valuable medium through which to sell equipment to machine shops and foundries.

hydraulic gates which the Midvale Steel Co. has contracted to construct for canal purposes at Detroit, Mich. It will be a four months' job.

The Wm. Powell & Co., of Cincinnati, O., found their business very good for the early months of last year and in the fall noted some recovery from the dullness of mid-summer. Thus far in 1894 they have had many more inquiries, bringing a fair share of orders. They regard the outlook as brighter.

At the annual meeting of the Midvale Steel Co., of Nicetown, Philadelphia, Pa., President Harrah reported that the past year was the most prosperous in the history of the corporation, and that enough orders are now on hand to keep the plant running to its full capacity for the next 14 months.

The shipments from the Eagle Mill, Ironton, O., last week, were 500 tons of bar and 100 tons of sheet iron. The warehouse contains 1,000 tons of bar iron and 200 tons of sheet iron. The finishing department is running and a week longer will be required to work up the stock of muck bar on hand.

A Providence, R. I., dispatch says that Elihu Thomson, of the General Electric Co., has concluded negotiations for the purchase of the extensive works of the Corliss Engine Co., which have been upon the market for a year. Street car motors and other electrical machinery will be manufactured and a large force of men employed.

The Ellwood Tin Plate Co.'s sheet mills at Ellwood, Pa., formerly the Ellwood Steel Co.'s plant, are to be changed into tin plate mills by the Leechburg Foundry & Machine Co. The mill will make black plate for tin plate, exclusively, but tinning will not be started at present. The mill will be run on three turns, and will have a capacity of 25 tons a day.

The directors of the Wm. Cramp & Sons' Ship & Engine Building Co., at a meeting in Phildelphia, last week, declared the regular quarterly dividend of two per cent. The capital stock of the company authorized is $5,000,000. The amount actually issued is $4,848,000. The company has mortgages on real estate amounting to $400,000 and collectable cash assets over all indebtedness after present dividend is deducted of $800,000, which is equal to eight per cent. on the stock outstanding. The company has contracts for work which will keep it busy as at present for over three years.

The situation among Hanging Rock charcoal iron producers is stated in the following paragraph from the Ironton, O., *Register:* "A furnaceman said Monday: We are selling No. 1 charcoal foundry to regular customers at $18 on board cars at the furnace. Consumers now take a carload at a time, and when it is nearly used up, order another car. They pay cash, or promptly on 30 days' time. Before the hard times they asked for and received 60 days' time and frequent extensions. Collections now are prompt and sure. Wages were never so low. Wood is being cut at the furnaces at 25 cents a cord, and, taking the winter through, the men and boys engaged in that kind of work do not, and cannot, make more than 25 cents a day each on an average. He also said, in effect, that the management at furnaces is closer than ever before, and that the cost of making pig iron, especially the cost of superintendence, has been reduced to the lowest point ever reached.

It is also remarkable that every one of the furnaces now in blast is making more and better iron than ever before."

AT no time are the great plants of the Carnegie Steel Co. without their tearing-down or their building up operations in some part of the works. The old 28-inch mill at the Homestead works will be torn down in the near future and a new mill built in its place. The cranes and tables will be operated by electricity, and the capacity of the new mill will considerably exceed that of the present one. About April 1 there will be a stoppage at Homestead, to put in a new blooming mill. When this work is completed, the Duquesne billet mill will shut down for the replacing of the blooming mill there with a new structure. The Edgar Thomson works which have run on billets for some time, resumed making rails this week.

IN another column will be found the advertisement of the Walburn-Swenson Co., 944 Monadnock block, Chicago, in which they offer for sale at very low prices a special list of new and second-hand machinery. Mining machinery, engines, pressure blowers, etc., are included, and the articles advertised are now at the works of the company at Chicago Heights, Ill.

THE business of the Magnolia Metal Co., in its sales of Magnolia metal, has increased 12 per cent. from January, 1893, to January, 1894, over the sales of the previous year, notwithstanding one of the greatest panics that the world has ever seen. It is said that the factory of this company has not closed down for a day on account of the depression, and a part of the time it had to run all night in order to keep up the company's orders for Magnolia metal. The outlook for the coming year of 1894 is reported to be bright, and the Magnolia Metal Co. anticipates an increase of at least 50 per cent. over 1893.

THE Neafie & Levy Shipbuilding Co., Philadelphia, have secured the contract for a steel passenger vessel for the West India trade. She will be 242 feet long, 35 feet beam and 20 feet depth of hold. The same company will build a steel passenger steamboat to ply between Baltimore and Washington. This will be 180 feet long, 40 feet beam and 12 feet depth of hold.

THE total exports of British iron and steel in January amounted to 161,804 tons, against 197,616 tons in January, 1893, which shows a decrease of 35,812 tons or 18 per cent. The decline in value was not so much in proportion, but it still amounted to £225,775, or 13.8 per cent., the value of the shipments in January last being £1,406,963, against £1,632,738 in January, 1893.

THE American Fire Brick & Clay Co., of Mineral Point, O., have issued a schedule of shapes, well printed and clearly illustrated, and announce that they will be glad to put them in the hands of all users of fire brick. They direct particular attention to their fire brick for blast furnaces, heating and puddling furnaces, their cupola blocks and boiler settings.

T. A. HAGERTY & Co., pig iron commission merchants, have removed their office from the 9th floor of the Rookery, Chicago, to room 451 of the same building.

THE office of Chas. Himrod & Co., Chicago, has recently been removed to room 451 The Rookery, from the 9th floor of the same building.

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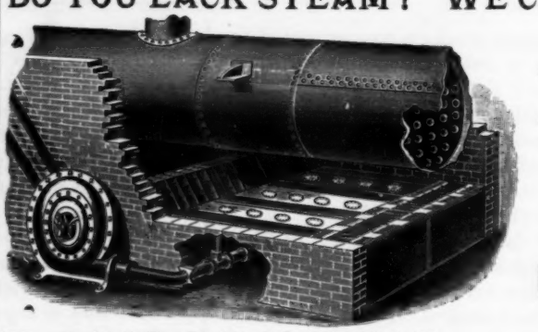

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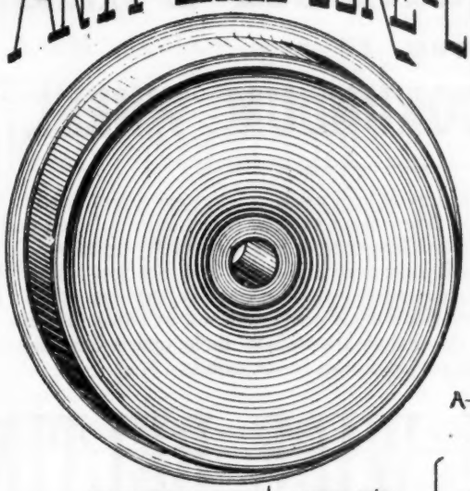

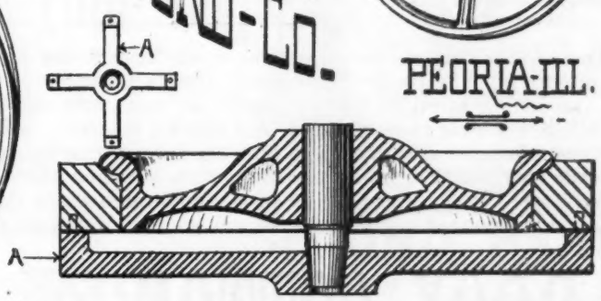

PATENTS APPLIED FOR { ABOVE SECTION SHOWS OUR PATENT PROCESS-BY-WHICH-WE-CURE A FINISHED HOLE IN AN ABSOLUTE CENTER

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OUR PATENT PROCESS EXPLAINED.

Instead of the present process of using a sand core, we use a metal core made of cold rolled steel shafting of the same size as the shaft on which the casting is intended to be run or used, turning out the castings ready for use, thereby saving from 50 to 75 per cent. on the dollar in machine finishing labor, such as boring, drilling, key-seating, feathering, etc., required when the sand core is used. This Metal Core before used, is coated by dipping into our compound, which prevents the molten metal fron adhering to the core, and also prevents all chilling, blowing, straining, cracking, etc., of the iron or casting.

PRICES FOR OUR COMPOUND.

Per Gallon.....$15.00 Per One-Half Gallon.....$7.50 Per Quart.....$4.00

DISCOUNT IN QUANTITIES ON APPLICATION.

Pulleys of all sizes, gear and sprocket wheels, car wheels of every description can be manufactured at a greatly reduced cost by using this compound

One gallon will coat or cover 500 square feet or 2,500 running feet of ¾ shafting. On this basis can be figured the total saving, which, of course, will depend largely on the size of the work being done and the size of core used, etc.

One gallon will turn out 20,000 common sized pulleys, saving on this work in machine labor alone, over $300.

The Metal Core may be used repeatedly, becoming better every time it is used, saving the re-making of sand cores and therefore making the cost of moulding less. To any one desirous of testing our compound, we will send a quart or half gallon can on approval, 30 days.

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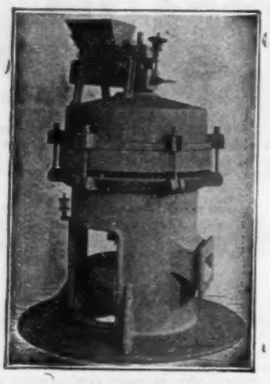

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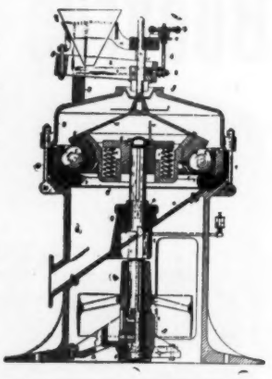

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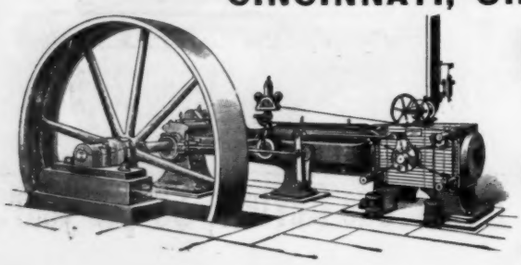

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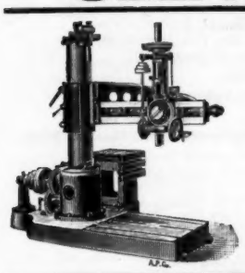

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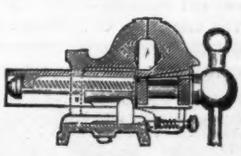

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Detroit Foundry Equipment Co., Detroit, Mich.

Land Companies—
Chicago Heights Land Association, Chicago, Ill.

Lathes—
Prentiss Tool & Supply Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
W. F. & John Barnes Co., Rockford, Ill.
W. H. Robertson, Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.

Laundry Machinery—
Chicago Laundry Machine Co., Chicago, Ill.

Link Belting—
The Jeffrey Mfg. Co., Columbus, O.

Machinists' Tools and Supplies—
Cincinnati Milling Machine Co., Cincinnati, O
Prentiss Tool & Supply Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O
W. F. & John Barnes Co., Rockford, Ill.
H. Bickford, Lakeport, N. Y.
W. H. Robertson, Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.

Machine Screws—
Illinois Screw Co., Chicago, Ill.

Machine Shops—
Toledo Machine & Tool Co., Toledo, O.
Harn, Ow & Co., Beaver Falls, Pa.

Mining Machinery—
Lake Shore Iron Works, Marquette, Mich.
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O.
Vulcan Iron Works Co., Toledo, O.
American Mining & Machinery Co., Cleveland.

Moulding Sand—
Garden City Sand Co., Chicago, Ill.
J. Downerd & Son Co., Zanesville, O.

Municipal Bonds—
Frank R. Biedler, Baltimore, Md.

Milling Machines—
Cincinnati Milling Machine Co., Cincinnati.
Prentiss Tool & Supply Co., Chicago, Ill.
W. H. Robertson, Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.

Mines and Mining Stock—
Frank R. Biedler, Baltimore, Md.

Mining Engineers—
Richard A. Parker, Marquette, Mich.

Ore Crushers—
Lake Shore Iron Works, Marquette, Mich.
American Mining & Machinery Co., Cleveland.

Paint—
Iron Clad Paint Co., Cleveland.
Jos. Dixon Crucible Co., Jersey City, N. J.
Berger Bros., Philadelphia, Pa.

Perforated Sheet Metal—
Harrington & King Perforating Co., Chicago, Ill
Aitchison Perforated Metal Co., Chicago.
Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Plumbers' and Gas Fitters' Supplies—
Berger Bros., Philadelphia, Pa.

Powder—
Hercules Powder Co., Cleveland.

Power Plants—
Weston Engine Co., Painted Post, N. Y.

Presses—
Toledo Machine & Tool Co., Toledo, O.
Cleveland Stamping & Tool Co., Cleveland, O.

Planers—
Prentiss Tool & Supply Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
W. H. Robertson, Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.

Portable Forges—
Foos Mfg. Co., Springfield, O.
Buffalo Forge Co., Buffalo, N. Y.

Pulleys—
Lane & Bodley Co., Cincinnati, O.
Power Hammers—
W. H. Robertson, Chicago, Ill.
Pulverizing Machinery—
Lake Shore Iron Works, Marquette, Mich.
American Mining & Milling Machinery Co., Cleveland, O.
Pumps (Steam)—
E. H. Jones & Co., Cleveland.
Brightman Stoker Co., Cleveland, O.
Radial Drills—
Bickford Drill & Tool Co., Cincinnati, O.
Railway Supplies—
Cleveland City Forge & Iron Co., Cleveland.
Rock Breakers—
Lake Shore Iron Works, Marquette, Mich.
American Mining & Machinery Co., Cleveland.
Rolling Mill Machinery—
The Lloyd-Booth Co., Youngstown, O.
Roofing (felt)—
Berger Bros., Philadelphia, Pa.
Consolidated Roofing Works, Columbus, O.
Rust Preventative—
Stevenson Bros. & Co., Philadelphia, Pa.
Sand and Chill Rolls—
The Lloyd-Booth Co., Youngstown, O.
Saws—
Peter Gerlach & Co., Cleveland.
Screws—
Illinois Screw Co., Chicago, Ill.
Schools—
Correspondence School of Mechanics, Scranton, Pa.
Second-Hand Machinery—
Prentiss Tool & Supply Co., Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.
W. H. Robertson, Chicago, Ill.
Chicago Laundry Machine Co., Chicago, Ill.
Steam Boiler Inspectors—
Hartford Steam Boiler Inspection & Insuranc Co., Hartford, Conn.
Smokeless Furnaces—
Brightman Stoker Co., Cleveland, O.
Sheet Iron—
Cleveland Rolling Mill Co., Cleveland.
Berger Bros., Philadelphia, Pa.
Steam Shovels and Dredges—
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O.
Vulcan Iron Works Co., Toledo, O.
Scrap Iron & Steel—
Klein & Cohn, Cincinnati, O.
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Wm. Jessop & Sons, Ltd. New York, N. Y.
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J. H. Fleharty & Co., Cleveland.
James Murdock, Jr., Cincinnati, O.
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Wm. Jessop & Sons, Ltd., New York, N. Y.
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Special Machinery—
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Cleveland Stamping & Tool Co., Cleveland, O.
Smoke Consumer—
Brightman Stoker Co., Cleveland, O.
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Screens for Coal, Ore Etc—
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Cleveland City Forge & Iron Co., Cleveland.
Tanks—
S. Freeman & Sons Mfg. Co., Racine, Wis.
Tinners' Hardware—
Berger Bros, Philadelphia, Pa.
Tinning Machinery—
The Lloyd-Booth Co., Youngstown, O.
Tool Steel—
Wm. Jessop & Sons, Ltd., New York, N. Y.
Tramways—
Trenton Iron Co., Trenton, N. J.
Trucks—
Detroit Foundry Equipment Co., Detroit, Mich.
Tumblers—
Detroit Foundry Equipment Co., Detroit, Mich
Turret Drills—
A. P. Quint, Hartford, Conn.
Twist Drills—
Cleveland Twist Drill Co., Cleveland.
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The Lunkenheimer Co., Cincinnati, O.
Berger Bros., Philadelphia, Pa.
Valve Gears—
Geo. Marshall, Fremont, Neb.
Vises—
Capital Machine Tool Co., Auburn, N. Y.
Ventilating Fans—
E. H. Jones & Co., Cleveland.
Brightman Stoker Co., Cleveland, O.
Washers—
Milton Mfg. Co., Milton, Pa.
Water, Gas and Steam Pipe—
Addyston Pipe & Steel Co., Cincinnati, O.
Radford Pipe & Foundry Co., Cincinnati O.
Well Drilling Machinery—
Williams Bros., Ithaca, N. Y.
Wheelbarrows—
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Wire Belting—
H. N. Green, 102 Vesey st., New York.
Wire Rope—
Trenton Iron Co., Trenton, N. J.
Wire Machinery—
John Adt & Son, New Haven, Conn.
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SOUTHERN TIMBER-MINERAL LANDS,
Before prices advance. All kinds of mines for sale.
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Terms Easy. CINCINNATI, O. Titles Perfect

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Investigate the
"Lunken" Renewable Seat Gate Valve.
The valve revelation of the age.
Satisfaction guaranteed.
If you once use it you will want none other in the future but the "Lunken."
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Circulars and prices on request.
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Cleveland Union Station.
Pennsylvania Lines.
Foot of Bank Street.
TICKET OFFICES at Station, Euclid Av., Woodland Av., and Weddell House corner.
THROUGH TRAINS RUN AS FOLLOWS BY CENTRAL TIME
* Daily. † Daily, except Sunday.

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Pittsburgh and Bellaire	† 7.45 am	†11.55 am
Pittsburgh, Bellaire and East	† 1.00 pm	† 6.25 pm
Philadelphia and New York	* 1.40 pm	*11.15 am
Baltimore and Washington	* 1.40 pm	*11.15 am
Alliance and Pittsburgh	* 1.40 pm	*11.15 am
Ravenna and Alliance	† 3.25 pm	† 9 50 am
Hudson and Ravenna	* 5 .0 pm	* 8.25 am
Philadelphia and New York	*11.10 pm	* 5.25 am
Baltimore and Washington	*11.10 pm	* 5.25 am
Alliance and Pittsburgh	*11.10 pm	* 5.25 am

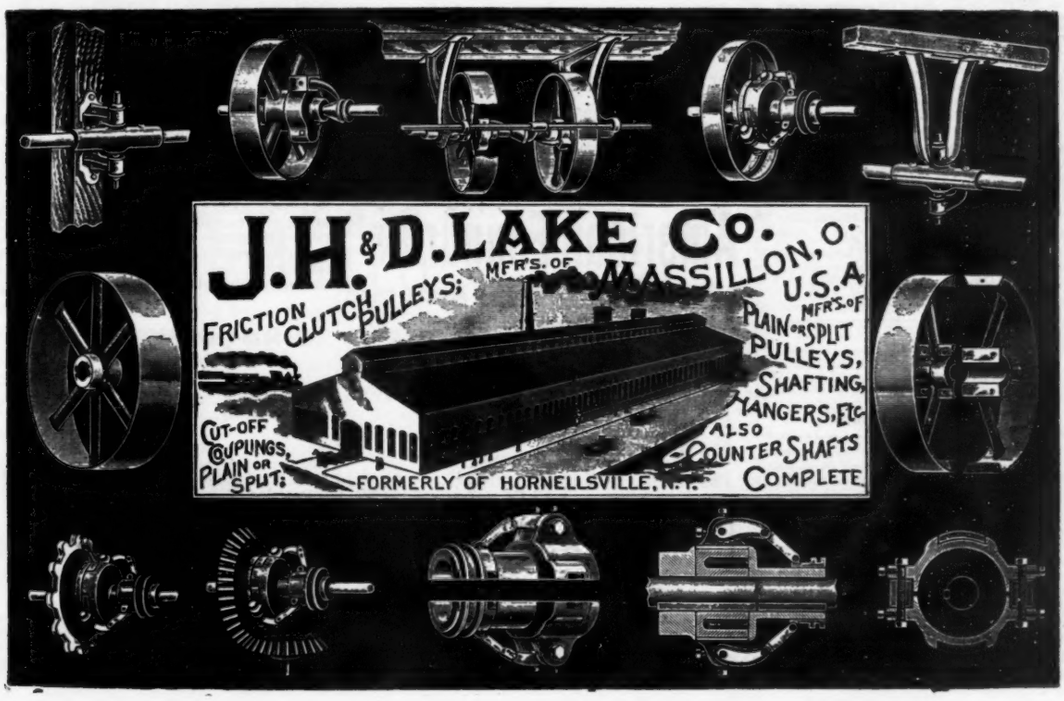
Mt. Vernon and Pan-Handle Route.

FROM CLEVELAND TO	LEAVE	ARRIVE
Xenia and Cincinnati	* 8.4c am	* 5.25 pm
Akron, Columbus & Zanesville	† 8.40 am	* 5.25 pm
Akron and Columbus	* 1.0c pm	†11.55 am
Akron and Orrville	† 3.25 pm	† 9.50 am
Columbus and Cincinnati	* 8.00 pm	* 7.00 am

Valley Ry.
Depot foot of So. Water St.
City Office 143 Superior St.

	Arrive.	Depart.
Akron & Canton	*6:40 P M	*7:10 A M
Akron, Canton & Valley Jctn.	*10:10 A M	*3:15 P M
Valley Jctn. & Way Stations	†6:40 P M	†7:10 A M
Akron, Canton & Chicago	*8:00 A M	*6:30 P M
Wooster and Garrett	†3:00 P M	†11:00 A M
Wooster	.....	*6:30 P M
Akron, Canton & Marietta	†3:00 P M	†11:00 A M
Steubenville, Wheeling, Washington, D. C., and Baltimore	†3:00 P M	†11:00 A M

†Daily except Sunday. *Daily. Pullman's Palace Vestibule Compartment Sleeping cars between Cleveland and Chicago.



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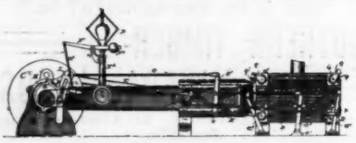
The name of the Chicago, Milwaukee & St. Paul Railway has long been indentified with practical measures for the general upbuilding of its territory and the promotion of its commerce, hence manufacturers have an assurance that they will find themselves at home on the company's lines.

The Chicago, Milwaukee & St. Paul Railway Company owns and operates 6,150 miles (9,900 kilometers) of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the lines of the company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota, and North Dakota, possess, in addition to the advantages of raw materials' and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle. Many towns on the line are prepared to treat very favorably with manufacturers who would locate in their vicinity.

Mines of coal, iron, copper, lead and zinc, forests of soft and hard wood, quarries, clays of all kinds, tan-bark, flax and other raw materials exist in its territory in addition to the vast agricultural resources.

A number of new factories have been induced to locate—largely through the instrumentality of this company—at towns on its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway, makes it possible to command all the markets of the United States. The trend of manufacturing is Westward. Nothing should be permitted to delay enterprising manufacturers from investigating. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

Address **LUIS JACKSON,**
Industrial Commissioner, C., M. & St. P. R'y.,
160 Adams St., CHICAGO, ILL.



Marshall Valve Gear

For operating the valves of a Corliss engine without the use of dash pot by means of a slotted link of the Porter-Allen type. Operates by means of an eccentric on the main shaft.

Far Superior to the Old Style of Valve Gear.

Send for circulars or other information to

GEORGE MARSHALL, Fremont, Neb.

"5,000 American Foundries"

Most Complete, Accurate and Up-to-Date

DIRECTORY of the FOUNDRIES of the UNITED STATES ever published.

JUST PUBLISHED BY THE

IRON TRADE REVIEW COMPANY,

27 Vincent St., Cleveland, O.

Price Postpaid $5.00.

IRON AND STEEL MARKETS.

IRON ORE.

[On Lake Erie docks.]

No. 1 Specular, Bessemer	3.00@ 3.25
No. 1 Bessemer hematite	2.75@ 3.00
Hematites No. 1 non-Bessemer	2.25@ 2.50
No 1. Specular, non-Bessemer	2.50@ 3.00

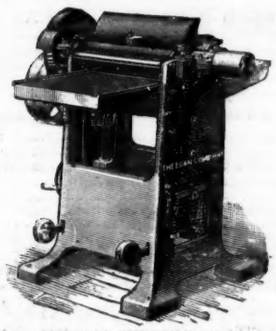
PIG IRON.

CLEVELAND (f. o. b. cars):	
Bessemer	$10 50@$10 65
No. 1 Strong Foundry	11 50@ 12 00
No. 2 Strong Foundry	10 50@ 11 00
No. 1 Grey Forge, red short	9 75@ 00 00
No. 2 Gray Forge, neutral	9 50@ 00 00
No. 1 American Scotch	11 65@ 12 00
No. 2 American Scotch	11 00@ 11 50
Lake Superior Charcoal	14 00@ 15 00
PITTSBURG:	
No. 1 Foundry	$11 25@$11 75
No. 2 Foundry	10 50@ 11 00
Grey Forge	9 50@ 9 75
White and Mottled	9 00@ 9 25
Warm Blast Charcoal	18 00@ 19 00
Cold Blast Charcoal	22 00@ 26 00
Bessemer	10 50@ 10 65
CHICAGO (reported by our representative:)	
Lake Superior Charcoal	$15 00@$15 50
Local Coke Foundry No. 1	11 75@ 12 25
Local Coke Foundry No. 2	11 25@ 11 75
Local Coke Foundry No. 3	11 00@ 11 50
Local Scotch Foundry No. 1	12 00@ 12 50
Local Scotch Foundry No. 2	11 75@ 12 25
Local Scotch Foundry No. 3	11 25@ 11 75
Southern Coke No. 1	12 00@ 12 25
Southern Coke No. 2	11 25@ 11 50
Southern Coke No. 3	10 75@ 11 00
Southern No. 1 Soft	11 25@ 11 50
Southern No. 2 Soft	10 75@ 11 00
Southern Silveries No. 1	12 50
Southern Silveries No. 2	11 75
Southern Gray Forge	10 00@ 10 25
Jackson Co Silveries	15 00@ 16 00
Ohio Silveries No. 1	14 50
Ohio Silveries No. 2	13 00
Ohio Strong Softeners	13 00@ 13 25
Alabama Car Wheel	18 25@ 18 60
Southern Charcoal No. 1	15 50@ 16 00
Southern Charcoal No. 2	15 00@ 15 50
CINCINNATI (reported by Rogers, Brown & Co.)	
Southern Coke No. 1, Foundry	$11 50@$11 75
Southern Coke No. 2 and No 1 Soft	10 50@ 10 75
Hanging Rock Coke, No 1	13 00@ 13 25
Hanging Rock Charcoal No. 1, Fdy	17 00@ 17 50
Tennessee Charcoal No 1	14 00@ 14 50
Jackson County Stone Coal No 1	14 50@ 16 00
Southern Coke, Grey Forge	9 50@ 9 75
" " Mottled	9 25@ 9 50
Standard Alabama Car Wheel	16 75@ 17 50
Tennessee " "	16 00@ 16 50
Lake Superior " "	16 50@ 17 00
BUFFALO (reported by Rogers, Brown & Co.)	
Mahoning and Shenango Valley, strong, No. 1 Foundry	$12 50
Mahoning and Shenango Valley, strong, No. 2 Foundry	12 00
Ohio Softener No. 1	12 50
Ohio Softener No. 2	12 75
Jackson Co. Silvery, No. 1	$15 80@ 17 30
Jackson Co. Silvery No. 2	15 00@ 16 00
Lake Superior Charcoal	14 75
Tennessee Charcoal	15 50
Southern Softener No. 1	12 50
Alabama Car Wheel	16 50@ 17 50
Hanging Rock Charcoal	18 50
LOUISVILLE (reported by Geo. H. Hull & Co.)	
Southern Coke No. 1 Foundry	$12 00@$12 50
Southern Coke No. 2 Foundry	10 50@ 11 00
Southern Coke No. 3 Foundry	10 00@ 10 50
Grey Forge	9 50@ 10 00
Spathite	12 00@ 12 50
Southern Charcoal No. 1 Foundry	13 00@ 14 00
Car Wheel	15 50@ 16 50
ST. LOUIS (reported by Rogers, Brown & Meacham):	
Southern Coke No 1	$11 75@$12 00
Southern Coke No. 2	10 75@ 11 00
Southern Coke No. 3	10 50@ 10 73
Southern Grey Forge	10 00@ 10 25
Southern Charcoal No. 1	15 50@ 16 00
Missouri Charcoal No. 1	13 00@ 13 50
Ohio Softeners	16 00@ 16 50
Lake Superior	17 00@ 17 50
Southern	17 00@ 17 50
Connellsville Coke, St. Louis	4 50

OLD RAILS AND SCRAP METAL.

[Prices paid by mills.]

	GROSS TONS
Old iron rails	$14 00
Old steel rails	12 50
	NET TONS
No. 1 R. R. wrought scrap	$10 00
No. 1 wrought scrap	9 50
No. 1 Machine cast scrap	9 00
Iron axles	16 00
Axle turnings	9 00
Wrought turnings (free from cast)	7 00
Cast borings	5 50
Uncut wrought iron boilers	4 50
Steel boiler Plates	9 50
Grate bars	4 00
Pipes and flues (clean)	8 00
Tank iron	7 00
Hoop and band iron	6 00
Sheet iron	6 00
Wrought drillings	6 50
Malleable iron	7 50



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Planes 18 in. wide and up to 6 in. thick.
No. 2—24 in. wide and up to 6 in. thick.

DESIGNERS AND CONSTRUCTORS OF
WOOD-WORKING MACHINERY
Especially adapted
For PATTERN MAKERS
and
General
WOOD WORKERS,
Etc.

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251 to 271 W. Front St., CINCINNATI, O., U. S. A.

We swept the field in the way of honors at the
WORLD'S FAIR, CHICAGO, '93.
Our machines are
PERFECT PRODUCERS of PERFECT PRODUCTIONS

PERFORATED METALS
OF ALL KINDS FOR
MILLING MINING AND AGRICULTURAL MACHINERY,
PERFORATED IRON, STEEL, COPPER, BRASS, TIN, ZINC, LEAD, ETC., TO ORDER.
LARGE AND VARIED ASSORTMENT OF SIZES. CORRESPONDENCE SOLICITED.
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OFFICE, ROOM 510 265 TO 269 DEARBORN STREET, CHICAGO, ILL. WORKS SOUTH CHICAGO.

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SHEETS, BARS, SLABS AND BILLETS.
Light Sheets for TINNING AND PERFORATING a Specialty.
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MANUFACTURERS OF HIGH GRADE FIRE BRICKS.
PITTSBURG, PA.

IRON CLAD PAINT CO.
Factory, 75 & 77 Central Way. Sec. & Treas., No. 3 Case Build'g.
CLEVELAND, OHIO.

Trade Mark Patented.

ORDER DIRECT FROM THE
Iron Clad Paint Co.
And get the genuine article, and save liability of suit for using an article made in violation of the patents issued to Wm. Green, and now owned by this Company.
IRON CLAD PAINT is the most durable, most fire-proof and Cheapest Paint made.
FURNISHED both Dry and Ground in Oil
USED BY NEARLY ALL THE RAILROADS.

Subscribe for the Iron Trade Review, $3 per year.

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. mill)	1.30c@1.35c
Angles	1.35c@1.40c
Tees	1.50c@1.60c
Universal Plates	1.30c
Sheared Plates	1.40c

MERCHANT IRON AND STEEL.

[List prices out of store.]

Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 60
4¼ to 6 by ⅜ to 1 inch	1 65
1¼ to 6 by 1¼ to 2 inch	1 80
1¼ & 1⅜ by ⅜ to ¾ inch	1 65
1 & 1⅛ by ⅜ to ¾ inch	1 70
⅝, ⅜, ⅞, by ⅜ to ⅝ inch	1 80

Round and Square.

1 to 1⅜ inch	1 60
2 to 2⅜ inch	1 70
2¼ to 3¼ inch	1 85
3⅜ to 4 inch	2 10
4¼ to 4½ inch	2 79
4¾ to 5 inch	2

Oval.

⅜ to 1¼ inch	1 80
⅝ to ¾ inch	1 80
½	2 00
⅜	2 20

Half Oval and Half Round.

1¼ to 3 inch	2 15
⅞ to 1½ inch	1 95
⅝ to ¾ inch	2 20
½	2 35
⅜	3 45

Heavy Band.

1¼ to 6 by ¼ and 5-16 inch	1 70
1 to 1⅜ by ¼ and 5-16 inch	1 75
¾ to ⅞ by ¼ and 5-16 inch	1 85
½ to ⅝ by ¼ and 5-16 inch	2 10

Hoop Iron.

1 7-16 to 4, No. 13, 14, 15 and 16	2 15
1 7-16 to 2, No. 17, 18 and 19	2 20
1 7-16 to 2, No. 20	2 30
1 7-16 to 2, No. 21	2 40
1 7-16 to 2, No. 22	2 50
1⅛ to 1¾, No. 13, 14 and 15	2 20
1⅛ to 1¾, No. 16, 17 and 18	2 25
1⅛ to 1¾, No 19 and 20	2 30
1⅛ to1¾, No. 21	2 40
1⅛ to 1¾, No. 22	2 50
15-16 and 1 inch, No. 13, 14 and 15	2 25
15-16 and 1 inch, No. 16, 17 and 18	2 30
15-16 and 1 inch, No. 19 and 20	2 40
15-16 and 1 inch, No. 21	2 50
15-16 and 1 inch, No. 22	2 60
⅞, No. 13, 14 and 15	2 40
⅞, No. 16. 17 and 18	2 50
⅞, No. 19 and 20	2 60
⅞, No. 21	2 70
⅞, No. 22	2 80
13-16, No. 13, 14 and 15	2 50
13-16, No. 16, 17 and 18	2 60
13-16, No. 19 and 20	2 70
13-16 No. 21	2 80
13-16, No. 22	2 90
¾, No. 13, 14 and 15	2 60
¾, No. 16, 17 and 18	2 75
¾, No. 19 and 20	2 85
¾, No. 21	2 95
¾, No. 22	3 05
11-16, No. 13, 14 and 15	2 85
11-16, No. 16, 17 and 18	2 90
11-16, No. 19 and 20	3 00
11-16, No. 21	3 10
11-16, No. 22	3 20
11-16, No. 23	3 30
⅝, No. 13, 14 and 15	2 90
⅝, No. 16, 17 and 18	3 00
⅝, No. 19 and 20	3 10
⅝, No. 21	3 20
⅝, No. 22	3 30
⅝, No. 23	3 40
9-16, No. 13, 14 and 15	3 10
9-16, No. 16, 17 and 18	3 20
9-16, No. and 20	3 30
9-16, No. 21	3 40
9-16, No. 22	3 50
9-16, No. 23	3 60
7-16 and ½ inch, No. 13, 14 and 15	3 30
7-16 and ½ inch, No. 16, 17 and 18	3 40
7-16 and ½ inch, No. 19 and 20	3 50
7-16 and ½ inch, No. 21	3 60
7-16 and ½ inch, No. 22	3 70
7-16 and ½ inch, No. 23	3 80
⅜, No. 13, 14 and 15	3 80
⅜, No. 16, 17 and 18	3 90
⅜, No. 19 and 20	4 00
⅜, No. 21	4 30
⅜, No. 22	4 40
⅜, No. 23	4 55

Light Band.

1½ to 6 by ⅛ to 3-16 inch	1 90
1½ to 6 by Nos. 11 and 12	1 95
1 to 1¾ by ⅛ to 3-16 inch	1 95
1 to 1¾ by Nos. 11 and 12	2 00
⅞ and 13-16 by ⅛ to 3-16 inch	2 10
⅞ and 13-16 by Nos. 11 and 12	2 15
¾ and 11-16 by ⅛ to 3-16 inch	2 20
¾ and 11-16 by Nos. 11 and 12	2 25
⅝ and 9-16 by ⅛ to 3-16 inch	2 35
⅝ and 9-16 by Nos. 11 and 12	2 40
½ by ⅛ to 3-16 inch	2 50
½ by Nos. 11 and 12	2 55

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	2 10
⅞ inch, " " " " 13 and 14	2 20
¾ inch, " " " " 11 and 12	2 25
¾ inch, " " " " 13 and 14	2 45

Sheet Iron.

No. 10	2 15
No. 12	2 20
No. 14	2 25

THE ADAMS
WATER TUBE BOILER.

This Boiler is absolutely safe from explosion. Gives as much steam from the waste heat as any boiler made. Easy of access for cleaning and repairs. Furnishes perfectly dry steam. Occupies little ground space. Economical in first cost. Send for complete circulars giving list of users and testimonials, one of which is printed below.

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Chas. P. Adams, Esq.

Dear Sir: The three boilers of 225 H. P. each which you furnished us are working in every way satisfactory. We consider them as good steamers as any we have ever used. Up to the present time have spent nothing on them for repairs. Very respectfully,

THE FALCON TIN PLATE & SHEET CO.,
By Warner Arms, Pres't.

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IRON AND STEEL WIRE OF ALL KINDS.
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NEW YORK OFFICE 17 BURLING SLIP
COOPER HEWITT & CO. TRENTON, N.J.
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The most Marvelous Lubricant Known.
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HERCULES,
THE GREAT STUMP AND ROCK
ANNIHILATOR.

SEND FOR DESCRIPTIVE PAMPHLET.

Stump before a blast. | Fragments after a blast.

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POWDER, FUSE, CAPS,
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AND ALL TOOLS FOR STUMP BLASTING,
FOR SALE BY THE
HERCULES POWDER COMPANY,
40 Prospect Street, Cleveland, Ohio.
J. W. WILLARD, Manager.

No. 15-17	2 35
No. 18	2 50
No. 20	2 60
No. 22-24	2 70
No. 25 26	2 80
No. 27	2 90

Steel Boiler Plates—1-4 in. and Heavier.

Tank	2 00
Shell	2 25
Flange	2 50
Marine Flange	2 75
Fire Box	3 75
Above includes plates 90 inches wide.	
90 to 96 in. wide	½c. ℔. extra
96 to 100 in. wide	1 c. "
100 to 104 in. wide	1½c. "
104 to 106 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. ℔s.
1 to 2 in. inclusive	08
9-16 to ½ in. "	08½
7-16 to ⅜ and 2⅜ to 3 in.	09
3⅛ to 4 in.	09½
⅜ to 11-16 and 4⅛	10
⅛ to 6 in.	10½
¼ to 9-32 and 6⅛ to 7 in.	11
3-16 in	13

Flats.

	cts. ℔s.
2 to 9-16 in. wide by 2 to ⅝ thick	8

Bessemer and O. H. Steel.

Machinery	base price,	2 10
Tire	"	2 25
Spring	"	2 50
Sleigh Shoe	"	2 50
Toe Calk	"	2 35
Cutter Shoes, tapered and bent	"	2 75

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	3 80
Bridge ½, ⅝, 11-16 and ¾ inch diam	3 50

MACHINERY SUPPLY MARKET.

Anvils.

American	℔ lb 9@10
Wright's	℔ lb 12

Bellows.

Blacksmiths'	Hill's	dis 40
	Bullock's	dis 50&10
Moulders'		dis 40@40&10
Hand		dis 40&10@50

Belting.

Boston Belting Co.'s standard	dis 70
" " " extra	dis 60&5
" " " best	dis 55
Cleveland Rubber Co. extra standard	dis 60&10
Hoyt's Short Lap	dis 45
Shultz Raw Hide Leather Belting, single	dis 40
Munson's Short Lap Single Leather	dis 45
Munson's Short Lap Double and Light Double Leather	dis 50
Shultz Raw Hide Leather Belting, Double and Light Double	dis 40
Standard, oak tanned	dis 50&10
Alexander Brothers' pure oak tanned	dis 45

Blowers and Exhausters.

B. F. Sturtevant's	dis 20
Boston Blower Co.	dis 35
Buffalo	dis 40

Chucks.

Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 30
" 2 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis 30
Horton's Universal	dis 40
" Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 40
Sweetland "	dis 40
Almond Drill	dis 20
Morse "	dis 15
Skinner's Combination Lathe	dis 40&10
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 20

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
Standard	dis 10@15
Morse	dis 15
Brown & Sharpe, Milling Cutters	dis 15
" " Gear Cutters	dis 15

Crowbars.

Cast Steel	℔ 3½
Iron, steel points	℔ lb 3

Drill and Drill Sockets.

Twist Drills	dis 50&10
Morse Taper and Straight Shank to 1½"	dis 50&10
Morse Taper and Straight Shank Larger than 1½"	dis 25
Drill Sockets	dis 25
Standard Twist Drills	dis 55@55&5
Cleveland " "	dis 55@55&5

Emery.

	No. 4 to No. 46 gr.	54 to Flour, 150 gr.	C. F F. FF.
Kegs, ℔	4½c	5 c	2¼c
½ kegs ℔	4¾c	5½c	2¾c
¼ kegs ℔	5 c	5½c	3 c
10 ℔ cans, 10 in case	6 c	6½c	5 c
10 ℔ cans less than 10	10 c	10 c	7½c

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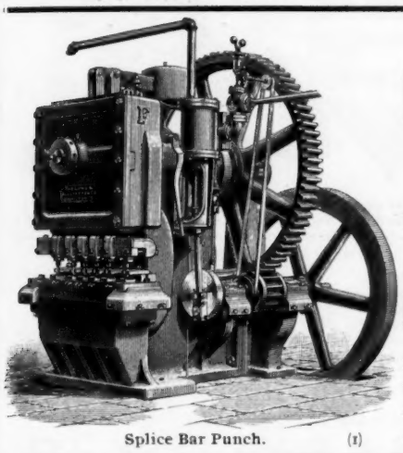

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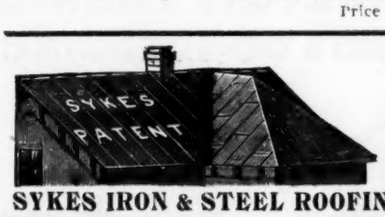

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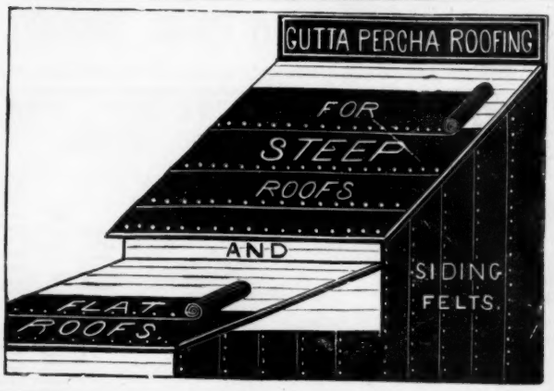

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Barder, Adamson & Co.	dis 50@50&5
H. H. Barton	dis 50@50&5

Emery Wheels.

Detroit	dis 55@60
Norton's	dis 55@60
Grant	dis 55@60
Sterling	dis 60
Celluloid	dis 10&33⅓
Northampton	dis 55
Crystal	dis 65@70
Vitrified	dis 60
Vulcanite	dis 60&10
Hamden	dis 60&10
Cyclone	dis 60

Files.

Arcade	dis 60&10@60&10&10
Nicholson	dis 60&10@60&10&10
" X. F.	dis 25
Kearney & Foot	dis 60&10@60&10&10
Black Diamond	dis 60&10@60&10&10
McClellan	dis 60&10@60&10&10
Disston's	dis 65@70
Western	dis 70
Stub's	dis 25
Grobet's	dis 30
Reynolds Bros.' Hand Cut	dis 50
Industry File Works Hand Cut	dis 50

Hammers.

P. S. W	dis 40
Atha new list, Jan. 15, 1887	dis 50
Heavy hammers and sledges under 5 lbs	15c
" " " " over 5 lbs	12c

Jack Screws.

Illinois Bolt Co. list	dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¼	4	3¼	3½
Hexagon	15½	11½	8½	6	5¼	5¼	
Washers	9	8	7	5	4½	4½	4½

In lots less than 100 lbs, ⅜ lb add ½c., 1 lb. boxes add 1c to list.

Nails (wire).

List July 14, 1887	dis 75
Standard Penny Nails, ⅜ keg card rate	
Car lots	$1.55
Less than car lots	$1.65

Oilers.

Zinc and Tin	dis 60
Brass and Copper	dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ⅜ doz	dis 10@10&10

Packing, Steam.

Boston Belting Co.	dis 60
American Packing Hemp	⅜ lb 9@10
Russia " "	⅜ lb 14
Italian " "	⅜ lb 13@19
Plumbago Piston	⅜ lb 40
Peerless	⅜ lb 60
Morrison's "	⅜ lb 50
Square Flax "	⅜ lb 50
Sheet Rubber	⅜ lb 12&24
Excelsior Rubber	⅜ lb 48
Rainbow	Full Rolls 45c ⅜ lb; Less than Full Rolls 50c ⅜ lb.
Eclipse Gasket	⅜ lb 75

Picks.

Railroads, 5 to 6 lbs	$12 dis 60
" 6 to 7 lbs	$13 dis 60

Pulleys.

Iron Pulleys, Walker List	dis 40
Medart Pulleys	dis 50
Split Wood Pulleys	dis 50@55

Rivets.

Iron, Thousand, list November 17	dis 50&10@60
Iron, Ordinary, Cooper's Block and Carriage list November 17	dis 50&10@60
Copper	dis 50@50&10

Saws.

Disston's Circular	dis 40&10
" Band	dis 25
" Scroll	Net
Hack Saw Stubs	dis 20
" " Eureka	dis 20
" " Star	dis 20
Saw Swages Diston's	dis 30
Atkins' Circular Saws	dis 40&45
" Mill, Mulay and Drag Saws	dis 40&10
" Wood Saws	dis 40&10
" Silver Steel Diamond Cross-cut Saws	70c per ft
" Dexter Cross-cuts	50c "
" Diamond "	30c "
" Tuttle Tooth Cross-cuts	25c "
" One-man Cross-cuts	32c "
No. 1 Handles	23c per pair
No. 6 "	16c "
Excelsior Saw Tools	$6 per doz
Derfection "	$15 "
Petroit Saw Works, Circular	dis 50
" " " Band	dis 25
" " " Mulay	dis 45

Taps.

Cards, Hand and Nut to 2 in	dis 50
Carpenters' " " "	dis 50
Morse " " "	dis 50
Pratt & Whitney " " new list	dis 10
Machine Screw Taps	dis 55
Pipe Taps to 2½ in	dis 70
Stay Bolt Taps	dis 25
Stove Bolt Taps	dis 55
Pulley Taps	dis 40

Vises.

Solid Box	dis 60
Parker's	dis 20@25
Prentiss	dis 20
Stephen's	dis 25@30
Barrett's	dis 30
Miller's Falls	dis 40
Merrill's	dis 15@20
Howard	dis 35

Wire.

New List, Jan. 18, 1884

Brass	dis 30
Copper	dis 40
Bright and annealed, Nos. 0@18	dis 70&10@75
" " Nos. 19@26	dis 75@75& 5
" " Nos. 27@36	dis 75&10& 5
Coppered Nos. 0 to 18, market list	dis 70@70& 5
Galvanized Nos. 0 to 18 " "	dis65& 5
Tinned market Nos. 0 to 18	dis 67½
Cast steel	dis 50
Tinned Broom Wire	dis 70&5@70&10
Annealed Fence, Nos. 8 and 9	dis 75
Annealed Grape, Nos. 10 to 14	dis 75
Stub's Steel Wire regular	95c ₩ lb dis 30

Wrenches.

Coe's genuine	dis 50
Girard Standard	dis 70&10
Agricultural	dis 75&10
Mechanic's	dis 55&10& 5
Bemis & Call's Combination	dis 35
Donohue's Engineers	dis 20&10
Lamson & Sessions Engineers	dis 60
Billings & Spencer's Drop Forged	dis 25
William's " "	dis 25
Alligator " "	dis 40

Bolt and Nut Works.

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Steel Stamps and Stencils.

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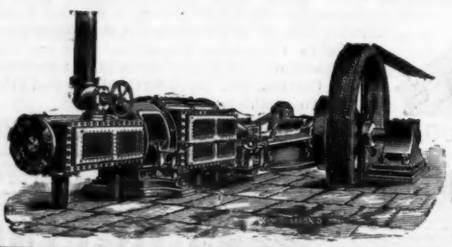

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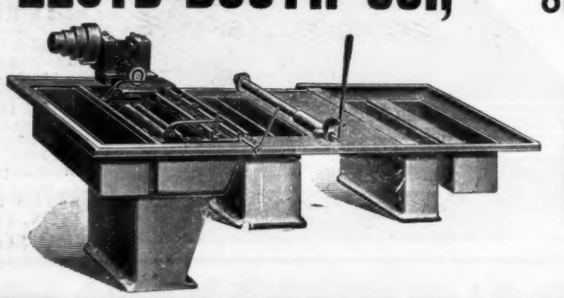

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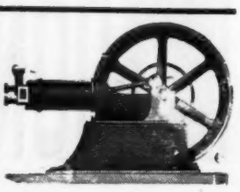

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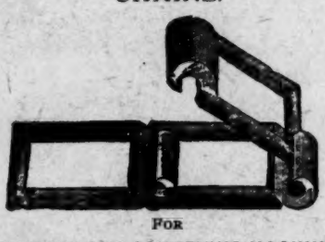

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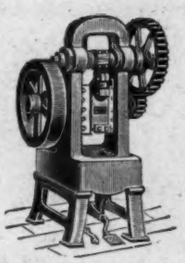

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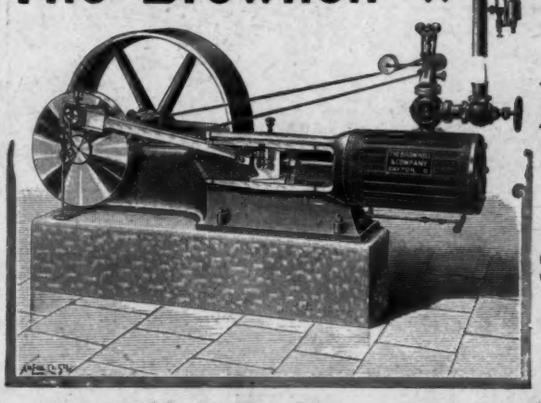

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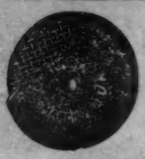

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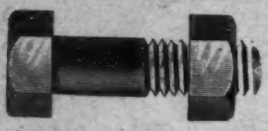

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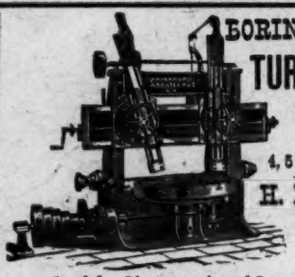

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